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TREPHINE OPERATION

PRESSURE AND DIRT IN THIS OPERATION, WITH NEW DEVICES FOR CONTROL *

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LOS ANGELES

For the past two years I have been interested in the unaccountable variation of results in the trephine operation for glaucoma simplex.

Two possible causes were studied: the first was pressure and unnecessary injury to the iris, zonule and ciliary region; the second, the amount of foreign substance that could be sequestered within the shaft of the ordinary tubular drill.

PRESSURE CONTROL

In April, 1930, I exhibited [1] the first attempt to eliminate pressure on the eyeball and even substituted tension during the Elliot operation. The fundamental idea was to draw the corneoscleral button up against the cutting edge by means of a suture placed in the button after it had been marked out by the drill (fig. 1). The suture (000 or 0000 twisted) and needle (Carrell) was the same as that used in a previously described [2] procedure for closing cataract wounds. The needle is inserted with the help of counterpressure from a prong (made by grinding down an old grooved narrow sclerostomy needle until two spurs or prongs result on account of the groove).

The real problem was to make a window in the trephine side extending down to within 1.25 or 1.5 mm. of the cutting edge. In case this was accomplished, the lower rim of the window would serve as an easily observable gage of depth, and at the same time, the button could be seen and the first flow of aqueous noted as the edge of the button retracted. It is undue pressure at this stage when the eye is softening that damages the structures below as they move upward with the release of the fluid of the anterior chamber.

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* From the Service of Eye Diseases of the Los Angeles County General Hospital, Unit 1.

1. Presented before the Eye and Ear Section of the Los Angeles County Medical Association, April 7, 1930, and reported in Am. J. Ophth. **13**:819, 1930.

2. Walker, C. B.: Exactly Appositional Sutures, Tr. Am. Ophth. Soc. **27**:51, 1929.

The window must serve also as an exit for the suture tension threads, which were used to draw the button up into the drill, thus avoiding pressure downward into the eye as it softened from loss of aqueous. The short distance of the lower edge of the window from the edge of the trephine permits the tension suture to take a wide variety of angles and pull the button in practically any direction. This apparently is a new use for the window. Thus, although there is a window high up

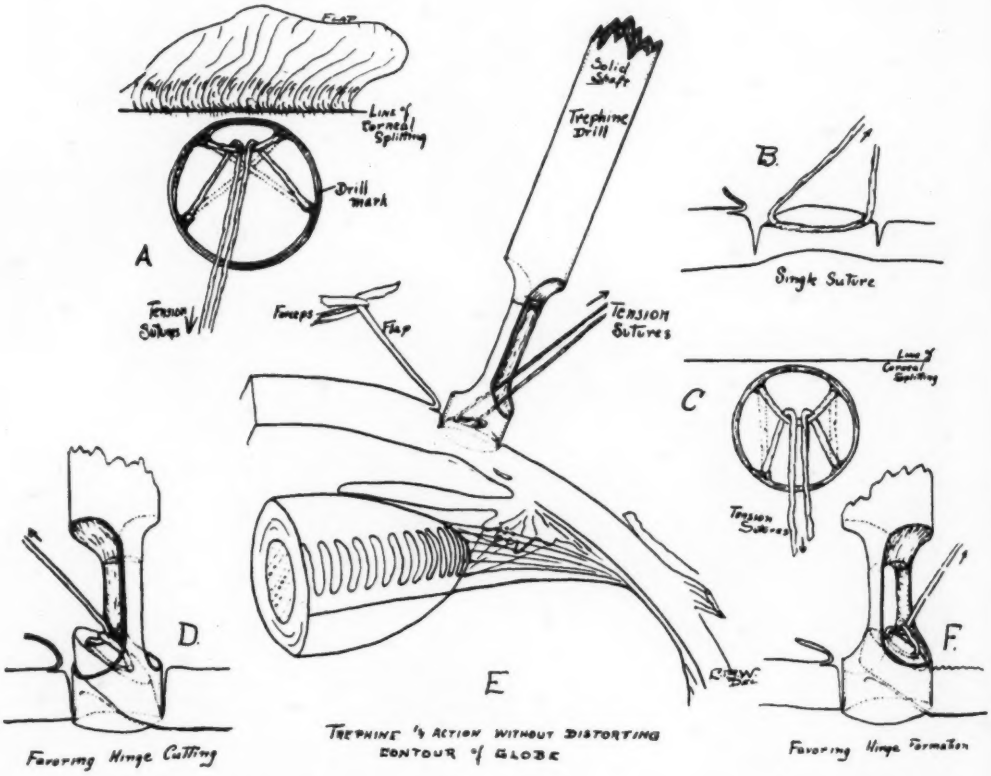

Fig. 1.—Drawing illustrating the steps in the procedure of using the stitch and window in the trephining operation. *A*, *B* and *C* show the various suture anchorage that may be used; *F*, the first opening with hinge formation; *D*, how the button may be more widely separated or removed, if desired, by rotating to change the angle of pull to the opposite side; *E*, the instrument in action on the corneoscleral button, without pressing the ocular contour inward.

on Wilder's drill, it was not intended for the aforementioned purposes. Also a fine corkscrew has been tried instead of a stitch, but it may puncture the lens, even if carefully used.

The use of a stitch, although entirely optional, gains other advantages such as (1) fixation of the globe; (2) fixation of the trephine in its track so that it does not have any tendency to slide about; (3) cutting

any side of the button first without tilting the drill, thus preventing one edge from cutting too deep in a narrow chamber; (4) complete removal of the scleral button, if desired, without cutting down on the iris and without scissors (fig. 1*D*), by changing the direction of the pull on the tension suture, i. e., the position in *F* to that in *D*.

CLEANLINESS AND SHARPNESS

In addition to these numerous advantages of the gage window, it also has great possibilities as regards cleanliness within the trephine.

A guard to prevent deep penetration is easy to add, but it obscures the vision slightly and acts as another dirt catcher unless frequently removed, in which case the drill is apt to be unexpectedly dulled. If the guard happens to be too low, a disagreeable incompleteness results. So far, the gage, increased visibility and the tension suture have given a more positive complete control.

Another advantage of the open-sided drill is the elimination of the pressure-suction pump action of the ordinary trephine. For instance, when the first opening is made into the anterior chamber on one side, the button, as seen through the window, retracts, and the sum of the pressure of the glaucoma plus the pressure of the trephine forces aqueous up the tube, but as about the same time leakage on the outside of the tube may also reduce the tension sometimes to a minus pressure, so that as the trephine is withdrawn, fluid trapped within the ordinary tubular windowless drill may be sucked to some extent into the anterior chamber, and with it may go the minute particles of hone dressing, perhaps steel, silica and rust, mixed with some oil or gum, any or all types of which may be loosened by the friction of drilling and be free to flush into the wound. While this dirt may be taken care of by the eye, a mild iritis, which leaves pigment deposited on the capsule of the lens and sometimes adhesions, is all too frequently seen.

While Elliot put much emphasis on the ease with which it is possible to stir up a quiet iritis or even iridocyclitis by pulling on the iris during the peripheral iridectomy, the Green brothers [3] go still further and try in every case to do the iridectomy or iridotomy with the scissors only, avoiding the use of iris forceps if possible. (To facilitate this, the button is hinged on the scleral side.) However, there are many ardent exponents of iridotasis and similar procedures, such as Greenwood's, in which the iris is not only freely incised radially but also drawn out of the wound and left so that considerable strain can be transmitted

3. Green, A. S.; Green, L. D., and Green, M. I.: Glaucoma, Arch. Ophth. **3**:297 (March) 1930.

to the ciliary body. Is it possible that iridotasis or iris tubulating operations are successful in spite of trauma because a trephine with its ordinary dirt hazard is not used?

Again, others have seen so much iritis that a full iridectomy is used regularly, as advised by Wilmer,[4] in order that closure of the fistula will not take place when the iris is drawn back with atropine, in anticipation of iritis or in actual treatment thereof.

Probably all will agree that dirt should be kept out of the wound and that pressure and traumatism should be reduced to a minimum because of the diseased, atrophic or irritable ciliary body in glaucoma simplex.

Fine particles in the bleb, which can be made out with the high power slit-lamp, are not always granules of pigment but may be foreign particles from the grinding paste dislodged from their original lurking place behind the microscopic teeth at the edge of the drill. It is well to remember that these teeth on a sharp drill tilt slightly inward and therefore are difficult to clean without dulling the drill. The inward tilt is due to the fact that the drill must be sharpened from the outside. They will resist rotary motion which does not bend them much, yet the usual axial motion such as must be used in cleaning an ordinary tube will take the finest teeth tips off rapidly, even if cotton is used. It should be done with benzine, alcohol, ether, carbon tetrachloride and high pressure air blast. If it is then necessary to wipe behind the teeth, binoculars, or better still, the slit-lamp, is used to obtain the greatest precision. This is extremely difficult without the use of windows such as I have described. The teeth also have a clockwise or counterclockwise pitch, according to which way the artisan twisted as he pushed the edge against the hone. The honing is always done against the edge with the same pitch as with ordinary old razor blades, with a slight rotary motion which gives a slanting draw about 20 degrees off the axial line.

It takes much time and care to clean the ordinary tubular windowless drill properly on the inside; and the average mechanic practically never does so, because it has not been demanded, because it dulls the drill and because sharpness has been the only requirement. Although the outside will be made to sparkle with buffing, if the drill is observed with the slit-lamp the inside is seen to be so dirty that no surgeon would use it if, for instance, it represented one side of a cataract knife. The surgeon can be safe only when he observes and cleans his own drills.

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4. Wilmer, H. W.: Discussion on the Operative Treatment of Glaucoma. Tr. Ophth. Soc. **47**:230, 1927.

I use a drill with an inside diameter of practically 2 mm. If a smaller opening is desired, it is simple enough and just as efficient to use more tilt and then punch or cut the button off at the proper sector for 1 or 1.5 mm. I believe the smaller sizes are being used less and less even for high tensions. One undoubtedly could safely standardize on the 1.75 mm. size.

With only one size of drill to consider, the problem of the chuck and handle is simplified, and one can use dimensions more in accord with other ocular instruments. The handle (fig. 4) is narrow enough so that the tendency of the drill to travel or slip on the eyeball is slight. There are a few operators who prefer to use the jeweler's method, so the handles have a suitably contoured tip to serve that pur-

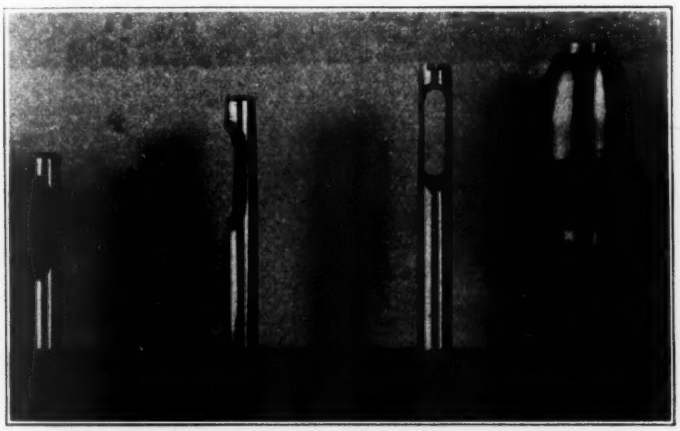

Fig. 2.—Double and single window trephines and chuck handle.

pose if desired. The milled edge of the upper border of chuck becomes a finger stop quite sufficient to limit downward travel of the fingers, and to enable one thereby to draw the fingers back to a more efficient position at any time without interrupting the motion of the drill. This maneuver is particularly advantageous to the majority of operators who do not use the jeweler's method of manipulating the instrument.

The first drills made were of the tubular type with a single window ground to 1 mm. or less from the lower edge, as shown in figures 2 and 3. From these it was learned that when the distance of the window was less than 1 mm. from the edge, disadvantages appeared; the edge was weakened and the thin ring could slip inside the wound and also little reserve was left for resharpening. At from 1.25 to 1.5 mm. from the edge these disadvantages disappeared, and good view of the button was still obtainable.

With the single window also it was learned that cleaning of the drill was still difficult in certain angles, and the long tube was always under suspicion concerning dirt and retention of strong fluids (compound solution of cresol or alcohol). Since now all good trephines are formed by drilling a hole through a rod of untempered steel and then grinding this down to a thin uniform tube, it was decided to drill the

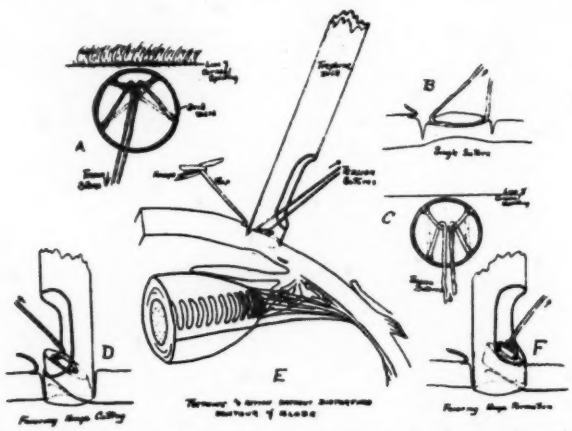

Fig. 3.—Single window trephine in operation as in figure 1, where the double window is shown.

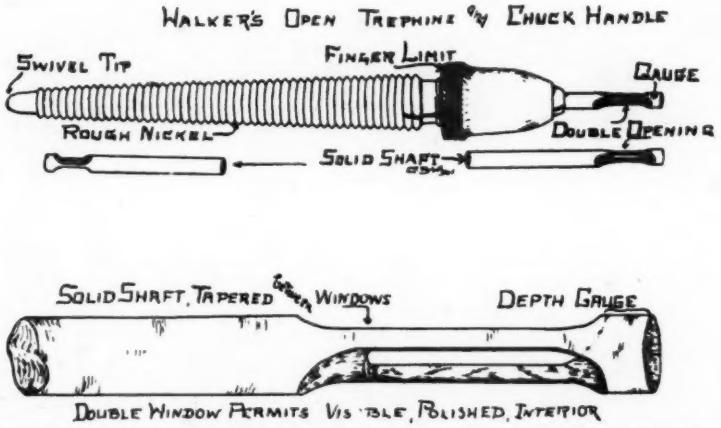

Fig. 4.—Double window drill with solid shaft and chuck handle.

hole only about 8 mm. deep leaving a solid shaft which could not collect dirt, etc. This drill was satisfactory with a single large window and is still made, because it is extremely sharp, clean and not so costly as my last design shown in figure 4.

In this last model a determined effort was made to polish every nook and corner inside the drill, bringing it to a finish as nearly equal to the outside as possible. To enable one to do this, I designed another

window opposite the first, leaving only enough steel between them to give sufficient strength and rigidity. This was somewhat difficult to work out but not nearly so difficult as the final polishing of the chamber and burred edges of the window, which had to be accomplished with chuck protection and a variety of dental tools. The polishing constitutes the most expensive, and I am sure the most valuable, part of the process.

With this clean, visible operation I have had no iritis to deal with, even in cases in which I expected it, as, for instance, in the opposite eye in which iritis had occurred previously when the old method had been employed in the trephine operation. It seems possible to me that late infection will be greatly reduced, for I have no doubt that dirt and foreign particles have an influence. It is necessary to hold the tip of the drill in a close-fitting clutch while the inside polishing is being done; otherwise the expansive pressure will fracture the thin steel. Naturally, also the first hole drilled must be made smaller than it used to be, in order to allow for the increased diameter produced by the inside buffing process.

A futher advantage immediately results from the use of the double window in addition to cleaning of all the inside portions, and that is the increased illumination and visibility of the button. Indeed, while it is being cut, the visibility of the button-cutting process is almost as great as it is when a cataract knife is being used in the periphery of the cornea.

I think that with this new trephine I have had the pleasure of observing for the first time the behavior of the button during the process of cutting. The following description is given in case a tension suture is not used.

The retraction of the edge of the button from the inside wall of the trephine is first noted. This is due to (*a*) the cutting of fibers under tension, (*b*) the inward tilt of the teeth and (*c*) the pressing back of the outside corneoscleral tissue by the increasing outside diameter of the drill as the drill penetrates. Then a thin dark crescent appears as the edge reaches Descemet's membrane. At this stage, the picture varies. In a shallow chamber the drill edge touches the iris after Descemet's membrane is cut, and a crescent of iris is seen to block the opening so that sometimes in eyes with low tension, no fluid appears to indicate penetration of the anterior chamber, because the iris is immediately present to block the opening. Further action of the drill will now do damage to deeper structures unless a change of tilt first to one side and then to the other side is made in order to widen the opening through Descemet's membrane. In this way it is easy and fairly safe to cut the edge of the button on the scleral side first as

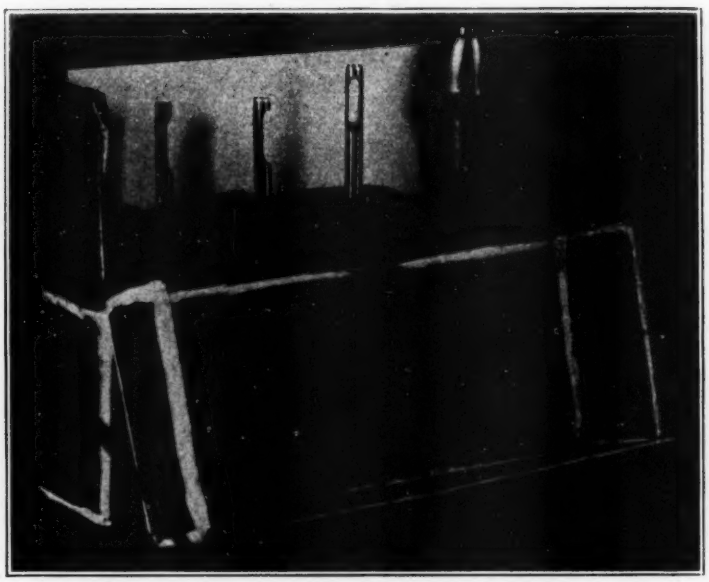

Fig. 5.—Instruments shown in figure 2, assembled in a convenient box with all the parts readily accessible without crowding.

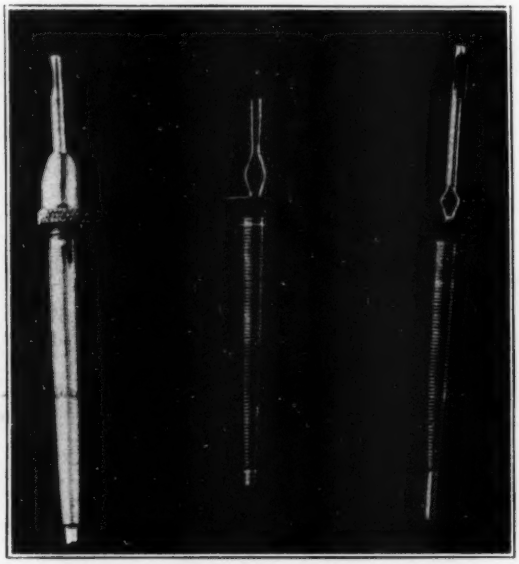

Fig. 6.—Various types of handles that have been tried both for solid shaft drills and hollow shaft drills.

described by Green,[3] except when the iris has an anterior synechia at that point, in which case, of course, the procedure shown in figure 1 of putting in a tension suture will be safer. In deeper chambers proportionately more fluid escapes before the iris comes up to block the opening and touch the drill edge. If blood instead of aqueous appears in the trephine, tilt the drill forward. The position is too far back or an adhesion is probably present; therefore tilt to cut on the corneal side first and hinge on the scleral side.

While all of the foregoing work can be done without the tension suture, yet I have always found it safer and better controlled with the

Fig. 7.—Specimen of tension suture attached to the button by method (*C*), shown in figure 1. The button is shrunken by fixation and later by drying, due to the heat of an arch light while focusing the microcamera.

suture, especially in producing a sufficiently wide opening in Descemet's membrane without pressure. Descemet's membrane in some cases is so loosely attached and so elastic that it may be seen with strong binoculars to curl back after the first semicircular perforation by the drill, as shown in figure 1*F*, and may escape the scissors as well as the drill. For this reason I always carry a Holth punch in trephine sets, much as one always takes a loop or lens spoon to an operation for cataract. The punch is safer than scissors for use so close to the iris and lens. I like to use the tension suture and transfer it at this stage from the drill to the punch, drawing the button accurately and delicately into exact position in the jaws of the punch. In this way Descemet's

membrane, often with iris pigment on it, will be found intact on the button (fig. 7). But always a trephine brightly polished on the inside, absolutely clean, of maximum sharpness and visibility is demanded.

To meet these requirements it seems to me that at least a single window, solid shaft drill as shown in figure 3 is necessary, and best of all, though more expensive, is the double window, solid shaft trephine as shown in figures 4 and 1.

After fully realizing the amount of dangerous dirt that can be hidden within an old-fashioned trephine, it has given me the greatest relief and comfort, even joy, to look into the highly polished, bright cleanliness of this new wide open model.[5] No longer do I fear the setback in vision, due to the operation itself, in the earliest stages of glaucoma simplex when there is much vision to lose and little to gain immediately. That stage certainly calls for the operation of greatest refinement.

CONCLUSION

It seems well worth while to inspect with strong light and binoculars the inside as well as the outside of all new, as well as used, trephines, to see that they are strictly clean and sharp before using them in operations for glaucoma.

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5. Further details concerning these trephines may be obtained from the U. S. Optical Company, 671 South Anderson Street, Los Angeles, who have arranged to have each drill slit-lamp inspected.

BACTERIUM GRANULOSIS IN TRACHOMA*

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The great majority of investigators believe that trachoma is an infectious disease caused by a specific micro-organism the identity of which has not yet been definitely established. Successful inoculation experiments on human beings and animals seem to prove the communicability of the disease beyond doubt. A great variety of organisms have been described as the cause of trachoma, but all have failed to produce the disease either in man or in experimental animals and have subsequently been shown to be only secondary invaders. The discovery, in 1907, by Halberstadter and von Prowazek [1] of characteristic intracellular inclusions in conjunctival scrapings from trachoma was a decided step forward, but the problem soon became complicated by the finding of similar inclusions in various types of nontrachomatous conjunctivitis. At present the inclusion theory does not receive wide acceptance.

A widespread revival of interest in the subject followed the publication in 1928 of a monograph by Dr. Hideyo Noguchi [2] of the Rockefeller Institute, who had made an intensive bacteriologic study of trachoma in American Indians. Dr. Noguchi became interested in the problem through the efforts of Dr. F. I. Proctor, who arranged the original expedition to the New Mexico reservations and also two subsequent ones.[3] Five untreated subjects, ranging in age from 9 to 15 years, were chosen who had advanced cases with scarring. Conjunctival material removed at operation was used in the inoculation of a wide variety of culture mediums. From semisolid leptospira mediums and blood agar plates containing a mixture of carbohydrates, incubated at 30 C., a distinct variety of minute gram-negative rod-shaped bacterium

* Submitted for publication, July 1, 1930.

* Read before the Section on Ophthalmology at the Eighty-First Annual Session of the American Medical Association, Detroit, June 26, 1930.

* From the Department of Ophthalmology, University of Colorado School of Medicine.

1. Halberstadter, L., and von Prowazek, S.: Deutsche med. Wchnschr. **33:** 1285, 1907.

2. Noguchi, Hideyo: Etiology of Trachoma, J. Exper. Med. **48:1** (Aug.) 1928.

3. Tilden, E. B., and Tyler, J. R.: Bacterium Granulosis and Trachoma, Science **70:**186 (Feb. 14) 1930.

was obtained in four of the five cases studied, in addition to a number of common bacterial forms. This organism, which apparently had never been described before, on injection into monkeys (*Macacus rhesus*) produced a granular conjunctival inflammation which closely resembled trachoma in man. For this reason Dr. Noguchi proposed the name *Bacterium granulosis.*

The bacterium was described as bearing a morphologic resemblance to *Corynebacterium xerosis,* though smaller and less resistant to decolorization. It differed from *C. xerosis* in a variety of characteristics, such as inability to grow on plain agar or broth at any temperature, colony morphology, motility and sugar fermentations. The organism moved by a single flagellum, which was usually attached to one of the poles, and motility could be demonstrated in both semisolid leptospira medium and blood agar cultures. Growth occurred on blood agar at temperatures varying from 15 to 30 C. but at 37 C. was either sluggish or absent. On leptospira medium the bacterium grew well at 37 C. and at lower temperatures. Colonies on blood agar appeared in about forty-eight hours as minute, shiny, somewhat raised, almost transparent round points, which on the following days gained in size and acquired a grayish opalescence and sticky consistency. Old colonies had a faint brownish or yellowish tint, and smears from these showed a great many involuted forms: club-shaped, polygonal, oval or even barred. The organism was nonsporogenous and bile-resistant, and failed to grow under strictly anaerobic conditions. Freshly isolated cultures were without appreciable action on carbohydrates, but after repeated subcultivation, the organism gained the ability to ferment slowly sixteen of the twenty sugars tested without inducing coagulation of the medium or producing gas.

The bacterium was entirely lacking in pathogenic action for rabbits, guinea-pigs, rats or mice, but when injected into the conjunctivae of monkeys (*Macacus rhesus*) it induced, after an incubation period of from two to three weeks, a conjunctivitis with follicles; in some animals this progressed to scar tissue formation but without pannus. Microscopic examination of excised tissue revealed the presence of conjunctival infiltration, follicle formation and scar tissue which seemed to resemble closely that seen in human beings. The failure to produce pannus in the animals was not regarded as significant, because previous investigators had been unable to produce it in monkeys directly inoculated with trachomatous tissue. It was concluded that the disease produced by culture exactly paralleled that produced by direct transmission with human materials. Dr. Noguchi was able to isolate the organism from the experimental lesions both early and late in the disease and also to transmit the disease from animal to animal by direct tissue inoculation. In view of his results, he concluded that *Bacterium granu-*

losis was the specific incitant of trachoma in man and of its equivalent, granular conjunctivitis, in monkeys.

Confirmatory reports have come from several different sources. Addario [4] reported before the Italian Ophthalmological Society in 1929 the finding of *B. granulosis* in Italian trachoma. In Egypt, Wilson [5] described the recovery in cases of trachoma of a small gram-negative rod which resembled the micro-organism of Noguchi, while in Russia Stepanowa and Azarowa [6] succeeded in isolating the organism in seven of the ten cases studied. In addition they were able to produce a follicular disease in three of four *Macacus rhesus* monkeys inoculated. In this country we [7] reported the finding of *B. granulosis* in four of six cases in which cultures were taken and the production of follicles in a single *Macacus rhesus,* with spreading of the disease to the uninoculated eye. More recent evidence in support of Noguchi's theory has come from the laboratories of the Rockefeller Institute, where Tilden and Tyler [8] reported the recovery of additional strains of *B. granulosis* from trachoma in American Indians, and Olitsky and Tyler [8] the recovery of the organism from trachoma in white persons in New York. A still more recent isolation has been reported by Kendall [9] in a case of trachoma in a white person in Chicago.

Adverse criticism has come from Lindner,[10] who examined three of the five Indian children from whom Noguchi had isolated *B. granulosis* and also the monkeys that had been inoculated at the Rockefeller Institute in New York. Two of the children were found to have active trachoma, but the other one had recovered completely, a fact which he believed cast doubt on the correctness of the original diagnosis. The monkeys he described as having a typical follicular conjunctivitis with normal conjunctiva between follicles, a condition not to be confused with true trachoma. He concluded that *B. granulosis* was not the cause of trachoma but probably one of the causes of follicular conjunctivitis. Lindner agreed, however, that other well developed cases of trachoma in Indians which came under his observation were identical with the disease in Egypt and in Europe. This is contrary to the state-

4. Addario, C.: Personal communication to the authors.

5. Wilson, R. P.: Preliminary Note on Bacteriological Researches in Trachoma, Bull. Ophth. Soc. Egypt **21**:39, 1928.

6. Stepanowa, H., and Azarowa, N.: Etiology of Trachoma, J. Microbiol. **8**:180, 1929; abstr., Arch. d'opht. **2**:357, 1929.

7. Finnoff, W. C., and Thygeson, Phillips: The Finding of B. Granulosis (Noguchi) in Trachoma, Am. J. Ophth. **12**:651 (Aug.) 1929.

8. Olitsky, P. K., and Tyler, J. R.: Bacterium Granulosis and Trachoma of a White Urban Population, Science **71**:263 (March 7) 1930.

9. Tilden, E. B.: Personal communication to the authors.

10. Lindner, K.: Is the Bacterium Granulosis of Noguchi the Cause of Trachoma? Arch. f. Ophth. **122**:391, 1929.

ment of Mayou[11] in England, who asserted that the disease in the American Indian was unlike that seen in Europe or Egypt. As far as we know, Mayou did not visit our Indian reservations and drew his conclusion on purely theoretical grounds. Mayou also reported the failure of British investigators to recover the organism or to produce experimental trachoma with cultures supplied by the Rockefeller Institute. V. Morax in France described the failure of this culture to produce the disease in six *Macacus rhesus* monkeys, which, however, had all died by the end of thirty days.[12] No conclusions could be drawn from these experiments with animals because of the insufficient incubation period. Additional failures were reported by Bruckner,[13] who attempted the isolation of *B. granulosis* in twelve cases, and by Sabata.[14]

AUTHORS' EXPERIMENTAL STUDIES

Our trachoma studies were begun in February, 1929, at which time we started the routine taking of cultures in all cases of trachoma seen both in private practice and at the ophthalmologic clinic of the University of Colorado School of Medicine. The work was made possible by Dr. Ivan C. Hall, professor of bacteriology and public health, who turned over to us the facilities of his department and who assisted us greatly by advice and direction. In the majority of instances, material for culture purposes was obtained by removing epithelial cells and follicular contents with a platinum spatula. In the first cases studied, the conjunctiva was previously anesthetized with sterile cocaine solution, but this procedure was discontinued after the inhibitory effect of cocaine on cultures of *B. granulosis* had been reported to us by Dr. Evelyn B. Tilden of the Rockefeller Institute. In six cases material was obtained during surgical procedures, four of these being expression operations and two tarsectomies. In all of these, 2 per cent procaine hydrochloride was used for anesthesia.

Twelve of our patients were white persons, one a Mexican and two Japanese; with two exceptions all showed pannus, typical scarring of the conjunctivae of the upper lids and shrinking of the culdesacs, in addition to other symptoms of advanced trachoma. Objections cannot be raised on the grounds that the disease in this group was atypical. These cases were studied bacteriologically and from six of them a bacterium apparently identical with that described by Noguchi was isolated. From three others, suggestive bacteria were recovered that have not yet been

11. Mayou, W. S.: Brit. J. Ophth. **13**:586 (Nov.) 1929.

12. Gifford, Sanford: Personal communication to the authors.

13. Bruckner, Z.: Present Views of the Etiology of Trachoma, Oft. Sbornik. **3**:1, 1929.

14. Sabata, J.: Trachoma at the Ophthalmological Clinic of Masaryk University, Oft. Sbornik. **3**:267, 1929.

completely identified. It may be stated here that cultures were repeated whenever negative; in some cases as many as four attempts were made before the organism was found. Only three of the patients had not received previous treatment, the remaining twelve having had treatment varying from the ordinary medical to radical operative measures. It is interesting to report that three of our first isolations were obtained from members of a German family living in eastern Colorado who had apparently contracted the disease from their parents, both of whom had become infected in Europe. Later the 8 year old son of one of these patients was brought to us with a rather marked follicular conjunctival disease of one year's duration which was probably trachoma, although neither scarring nor pannus was yet present. Cultures were made on one occasion, and a small gram-negative rod was recovered which was at first thought to be *B. granulosis,* but which later showed atypical sugar fermentations and which was consequently discarded. Descriptions of the cases from which positive cultures were obtained are cited in table 1.

An additional opportunity to study trachoma came through Dr. F. I. Proctor, who arranged for one of us (P. T.) to visit the Leupp Indian School in the Navajo territory near Winslow, Ariz. No physician had been on duty at this school for some six months previously and consequently no regular treatment had been carried out during this period. Fourteen cases were selected by Dr. Polk Richards of the Indian Medical Service as suitable for study. Five of these patients showed definite scarring, thus making the diagnosis of trachoma certain, and two others showed signs of beginning scar formation. Only one patient showed pannus. The other six had a disease of recent onset with marked folliculosis and infiltration of the conjunctiva, involving both the caruncle and the semilunar fold. The picture here suggested trachoma, but, in the absence of scar formation and pannus, the diagnosis could not be made with certainty. An individual description of each of these cases is presented in table 2.

Material for culture purposes was obtained by expressing the follicular contents with forceps after preliminary anesthesia with 0.5 per cent procaine hydrochloride, except in cases 1, 2 and 5, in which ether was employed. This material was used without preliminary maceration in the streaking of blood agar plates and also in the inoculation of tubes of leptospira medium. Only sufficient medium for ten cases was brought from Denver, the rest being obtained from Dr. E. B. Tilden of the Rockefeller Institute, who was taking cultures in the same cases and for whom the expedition had been originally arranged. The plates were sealed immediately with adhesive tape to prevent drying of the medium and were not examined until six days later on our return to Denver. It was unfortunate that the time the cultures were taken a high wind was blowing which caused a constant sifting of sand through

TABLE 1.—*Private and Clinical Cases of Trachoma Yielding Cultures for Bacterium Granulosis*

Number and Name	Race	Sex*	Age	Cultures: Leptospira	Cultures: Blood Agar	Monkey Inoculated	Private or Clinic Case	Treated or Untreated	Clinical Appearance
1. A. Z.	W	♂	22	+	..	...	P	T	Scarring of lids; shrunken culdesac; scattered follicles; severe pannus and corneal ulceration; duration, 16 years
2. P. Z.	W	♂	28	+	..	#13† # 2 #12	P	T	Same condition as in case 1
3. P. Z. Jr.	W	♂	6	±	—	#12†	P	U T	Numerous follicles in upper and lower culdesacs and smaller ones on upper tarsus; secretion; no pannus; duration, 1 year
4. J. Spomer	W	♂	31	—	+	...	P	T	Extensive scarring in upper lid; shrunken culdesacs; extensive pannus and ulcers of cornea; duration several years
5. Mary Swindt‡	W	♀	25	+	..	...	P	U T	Scar tissue in upper lids; numerous follicles, + in right; pannus in right eye; duration, 9 years
6. H. B. Coulter	W	♂	35	—	—	...	P	T	Monocular trachoma; scars in right upper lid; follicles over tarsi; culdesac shrunken; pannus with recurring corneal ulceration; left eye normal; duration, 3 years
7. Laura A.	W	♀	22	+ ±	..	#11 #18	C	T	Fulminating trachoma with numerous follicles and scarring of lids; advanced pannus and recurrent corneal ulcers; duration, several years
8. C. F. R.	W	♂	28	—	±	#12	P	T	Induration of lids right eye, scars in lids; pannus; duration, several years
9. L. Nippert	W	♂	35-40	—	—	...	C	T	Trachoma with follicles; pannus; corneal ulcers; extensive scarring; duration, several years
10. Steve Kossa	W	♂	42	—	+	#14 #10 # 8	C	T	Scarring, pannus and corneal ulcer; duration, many years
11. M. A.	W	♂	19	—	—	...	P	T	Ptosis; extensive follicles; no pannus or scarring; duration, 4 weeks
12. F. Young.	W	♂	42	—	—	...	P	T	Scarring of lids; shrinking of culdesac; pannus and corneal ulcer; duration, several years
13. Marie Torres	Mex.	♀	28	—	±	...	C	U T	Follicles, pannus and corneal ulcer; no scarring; duration, short
14. Ike	Jap.	♂	62	—	—	...	P	T	Extensive scarring of tarsi, mild entropion, culdesacs obliterated; pannus and corneal scars; duration, many years
15. Sasaki	Jap.	♂	51	—	+	...	P	T	Extensive scarring of tarsi, mild entropion; culdesacs shrunken; pannus and recurring corneal ulcers; duration, many years

* In the tables, ♂ indicates male; ♀, female.
† Pooled strains Z6, Z5, Z2, P.Z.Jr.
‡ Sister of A. and P. Z.

the windows and skylight of the operating room. As a result the majority of plates were heavily contaminated with molds, which in many cases completely overgrew the plates by the sixth day. The leptospira medium cultures fortunately were relatively free from contaminants, and it was from these that the two isolations of *B. granulosis* were made (cases 2 and 13). Positive cultures were obtained in cases 1, 2, 4 and 5 by Tilden and Tyler.[3] It may be stated here that epithelial smears were made in each of the cases studied, stained with Giemsa stain, and searched under oil for inclusion bodies and also for bacteria resembling *B. granulosis*. Unmistakable inclusions were found in three cases and in four other small rod-shaped micro-organisms morphologically like *B. granulosis* were found on epithelial cells.

TABLE 2.—*Clinical and Cultural Study of Navajo Indian Children at Leupp School in November, 1929*

		Age	
1.	Juliet Dabb	10	Extensive follicle formation with scarring; treated
2.	Fay Chee	14	Marked follicle formation with scarring of left lower lid; disease of at least three years' duration; treated; B. granulosis recovered
3.	Kenneth Schultz	16	Healed trachoma with scarring of right eye; active disease with follicles and pannus in left eye; treated
4.	Hattie	..	Massive follicles; recent case; no scarring; untreated
5.	Henrietta Williams	6	Extensive follicles; no scarring; treated
6.	Everett Monroe	10	Many follicles; no scarring; left eye normal; untreated
7.	Patricia Thompson	7	Marked follicle formation; no scarring; treated
8.	Ida May Sanclati	..	Massive follicles; no scarring; large follicle on caruncle; untreated
9.	Marjorie Nilthsoni	9	Few follicles in retrotarsal fold of right eye; marked conjunctival thickening; left eye more pronounced; no scarring; treated
10.	Bonita Hash Ha	9	Scarring of lids; shrinking of retrotarsal fold; treated
11.	Kathlyn Williams	7	Acute disease; treated with mild silver protein the previous week; no scarring
12.	Margaret Curley	9	Treated since 1927; slight scarring of left lower tarsus; marked follicle formation
13.	Martha Keems	9	Beginning scar tissue formation; no treatment; B. granulosis recovered
14.	Elvalee House	7	Beginning scarring; treated

TECHNIC OF ISOLATION

It has been the custom when the isolation of *B. granulosis* from blood agar plates was attempted to keep them sealed with adhesive tape for six days unless a surplus of moisture collected or unless the plates were threatened with overgrowth by molds. At that time the plates were opened and all suspicious colonies were transferred either to blood agar slants or to tubes of semisolid leptospira medium, which were then incubated at 30 C. until growth appeared. Colonies were considered suspicious which had the characteristic moist grayish transparency that seemed typical of the organism. Frequently it was necessary to subculture colonies which were extremely small and which appeared only as minute drops. In that case a hand lens was used, the needle was introduced beneath the colony and removed it intact on a small bit of

agar. After first isolations had been made, the plates were resealed and kept in the incubator at 30 C. until the tenth day and then reexamined. In two instances *B. granulosis* colonies were found which had been overlooked on the sixth day. It was rare to find more than one or two typical colonies on a single plate.

Isolation of *B. granulosis* from semisolid leptospira medium cultures was complicated by the almost invariable presence of the common conjunctival contaminants, such as *C. xerosis* and white staphylococci. From case 3, however, a pure culture of the organism was obtained, which constituted the second isolation from this patient. Both first and second cultures produced extensive folliculosis in monkeys. It seemed wisest to attempt isolation of *B. granulosis* from the leptospira medium tubes on about the fourth day, as the bacterium had reached sufficient growth by this time, and the contaminating organisms had not yet completely overgrown the culture. The growth was then streaked out on blood agar plates in such a way that the resultant growth would be light enough for the observing and picking of individual colonies. These plates were incubated at 30 C. for from three to four days and were then examined for suggestive colonies, which if present were then transferred to slants or tubes. If first attempts at isolation proved unsuccessful, they were repeated unless direct smears from the original cultures showed a complete absence of morphologically suggestive rods.

It was soon found that many colonies had been grown in subculture which were not *B. granulosis*. As this organism has a typically moist grayish confluent growth on blood agar, we were able to discard rapidly many subcultures that did not show this type of growth. Subcultures were then checked for motility, morphology and staining reactions; if these proved characteristic, the strains were tested for fermentative action. The latter proved fairly constant for all strains studied and is probably the best means of identification of *B. granulosis*.

Morphology and staining reactions alone cannot be relied on for identification, as eight different types of motile gram-negative rods recovered from cases of trachoma have shown, under certain conditions, a morphology indistinguishable from that of *B. granulosis*. Among these is a chromogenic rod which may correspond to that recovered by Noguchi from the cases in Albuquerque. All differ from *B. granulosis* in essential biologic characteristics, especially in regard to sugar fermentations. One organism (Leupp 13), however, which was isolated from one of the Indians studied appears of especial interest in that it may be a variant of *B. granulosis*. This seems the more likely in that it has produced a transient folliculosis in one animal (monkey 17) and in addition gives characteristic fermentation reactions.

The medium that we have used for all cultivation experiments has been prepared for us by Miss Lillie O'Toole of the department of

bacteriology, according to directions sent to us by Dr. Simon Flexner of the Rockefeller Institute. Owing to the great difficulty in obtaining horse blood, human and occasionally rabbit blood has been substituted. Human blood seems as satisfactory as that from the horse, but rabbit blood is definitely inferior. This applies only to the preparation of agar plates, as rabbit serum and hemoglobin are satisfactory for use in preparing the semisolid leptospira medium. For maintaining subcultures, rabbit blood agar without carbohydrates has been used with satisfaction.

RESULTS OF CULTURAL STUDIES

The cultural characteristics of the eight proved strains of *B. granulosis* that we have isolated have been remarkably constant and seem to agree in every instance with those exhibited by two strains (Albuquerque 1 before and after passage through *M. rhesus* 81) of the organism obtained from the Rockefeller Institute. We were much disturbed at first to find that after repeated subcultivation our strains developed a luxuriant growth on plain agar, a fact not coinciding with the description of the organism in Noguchi's monograph. There he stressed as an essential property the inability of *B. granulosis* to grow on plain broth or agar at any temperature. This, however, is true only for recent isolations, as the two Noguchi strains have grown as well on plain agar as have ours. That the organism is not a true hemophil is shown also by the fairly luxuriant growth of all strains on peptone broth. Growth on dextrose broth does not occur, but brain medium, which is a mixture of calf's brain with 2 per cent peptone broth containing 0.1 per cent dextrose, has been found satisfactory in maintaining growth of the organism for as long as three months.

The bacterium is a minute gram-negative rod (fig. 1) which in very young cultures may be slender but when older usually takes a shorter form with rounded ends. In old cultures on blood agar many varied involution forms occur, but on leptospira medium the morphology remains constant. We understand that Morax [15] considers *B. granulosis* to be gram-positive, and it is true that a certain amount of the gentian violet is retained after decolorization; but this is completely masked by any of the usual counterstains, such as bismarck brown, safranin or dilute fuchsin. For this reason we have considered the bacterium definitely gram-negative.

Colonies on blood agar containing carbohydrates usually appear in about thirty-six hours as tiny transparent or slightly grayish droplets which later gain in size and coalesce. When examined under the low power of a microscope, the colony is seen to be slightly raised with a

15. Morax, V., and Petit, P. J.: Le trachome: conjunctivite granuleuse, Paris, J. Morax, 1929.

perfectly smooth border. The growth is characteristically of a somewhat sticky consistency, and great difficulty is found in attempting to break up clumps when suspensions for agglutination reactions are prepared. Old cultures tend to take on a definite brownish or yellowish tint, which we have interpreted as true pigment formation.

Growth occurs best between 28 and 30 C. but is good at room temperature. On semisolid leptospira medium the bacterium grows at 37 C. as well as at lower temperatures, but on blood agar the growth is either scanty or absent at 37 C. The organism is sensitive to heat, and ten minutes at 60 C. suffices to cause complete destruction. Drying also rapidly destroys the organism, which seems to have an indefinite life in the presence of sufficient moisture. Cultures have been main-

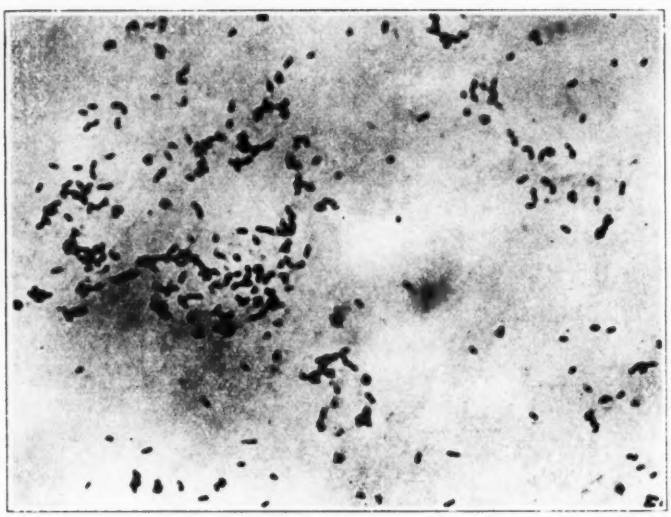

Fig. 1.—Bacterium granulosis; agar culture. Reduced from a magnification of 1,480.

tained on leptospira medium for several months at room temperature when protected from desiccation.

Motility has been observed in all strains both in leptospira medium and in blood agar cultures. The single flagellum described by Noguchi has been demonstrated in six strains, both by the Zettnow-Fontana stain [16] and by the recent one described by Bailey.[17] The flagellum was always seen attached to one of the poles.

The organism is nonsporogenous and apparently devoid of capsule, although the slimy, sticky growth would suggest this. Capsules have been consistently demonstrated, however, in Leupp 13 (fig. 2), which

16. Zettnow: Ueber Geisselfärbung bei Bacterien, Ztschr. f. Hyg. **30**:95, 1899.

17. Bailey, H. D.: A Flagella and Capsule Stain for Bacteria, Proc. Soc. Exper. Biol. & Med. **27**:111, 1929.

TABLE 3.—*Fermentation Tests* *

	Noguchi A	Noguchi B	D 1	D 2	D 5	D 6	D 7	L 2	L 13†	Macacus rhesus 11
1. Dextrose	++++	++++	++++	++++	++++	++++	++++	++++	+++	++++
2. Levulose	++++	++++	++++	+++	++++	++++	++++	++++	++	++++
3. Mannose	++++	++++	++	++++	+++	++++	++++	++++	++	++++
4. Saccharose	++++	+++	++++	++++	++++	++++	++++	++++	+++	++++
5. Raffinose	—	+	—	—	+	—	—	+	+	+
6. Inulin	—	—	±	+	++	±	+	++	++++	—
7. Galactose	++	+++	++++	+++	++++	+++	+++	+++	+++	++
8. Maltose	++++	++++	++++	+++	+++	++++	++++	++++	++++	++++
9. Salicin	++++	++++	++++	++++	++++	+++	+++	+++	++++	++
10. Xylose	+	+	+++	+++	++++	+++	+++	+++	+	±
11. Mannitol	++++	+++	++++	+++	++++	+++	+++	+++	+++	++++
12. Dextrin	++++	+++	++++	+++	+++	++++	+++	+++	++++	+++
13. Arabinose	+++	++	+++	+++	+++	+++++	+++	+++	++	+
14. Amygdalin	+++	++++	++++	+	+++	+++	+++	++++	+++	±
15. Lactose	++	++	+	—	+	±	—	++	±	++
16. Dulcitol	—	—	—	—	—	—	—	—	—	—
17. Rhamnose	+++	+	+++	+	++	++++	—	—	—	++
18. Trehalose	++	++	+++	+	++	+++	+++	+	++	—
19. Sorbitol	—	—	—	—	—	—	—	—	—	—
20. Inositol	—	—	—	—	—	—	—	—	—	—

* The readings were determined after twenty-one days at room temperature. D 3 was lost before it was tested.
† Atypical, because of capsule formation.

will be described later, and which we believe to be a true variant of *B. granulosis*. In the complete absence of oxygen, no growth occurs. Indole is not formed on mediums containing peptone, but nitrates are readily reduced to nitrites.

Fermentation tests have been of the utmost value in identifying the organism, as the results have been quite constant in the eight proved strains isolated by us and also in two strains obtained from the Rockefeller Institute. The tests are recorded in tables 3 and 4. We originally used the Hiss serum water medium described by Noguchi,[2] but changed to Dunham's peptone water containing 1 per cent carbohydrate and 1 per cent Andrade indicator after this was suggested to us by Dr. E. B. Tilden of the Rockefeller Institute. We have found this medium

Fig. 2.—Capsule stain of Leupp 13. Reduced from a magnification of 1,480.

extremely satisfactory in that final readings can be obtained by the tenth day after incubation at 30 C. Acidification occurs equally well, though not quite so rapidly, at room temperature. Lactose, inulin and xylose are usually affected late, but acidification of some of the other mediums may occur as early as twenty-four hours after inoculation. No gas is formed.

As mentioned before, a number of motile gram-negative minute rods have been isolated which differ from *B. granulosis* in one respect or another. One of these, Leupp 13, which was isolated from one of the Indian patients (Martha Keems), deserves especial mention because of the fact that it has produced a transient folliculosis in one animal (monkey 17) and in addition has given fermentation reactions that are identical with those of typical strains of *B. granulosis*. The organism presents a more mucoid growth, which persists even when a medium

that does not contain carbohydrates is used. Young cultures have definite capsules (fig. 2), which may not be present in older cultures. The organism retains the gentian violet more strongly than does *B. granulosis* and may even seem to be gram-positive at times. Young cultures on blood agar incubated either at room temperature or at 30 C. appear definitely motile, though two attempts to demonstrate the presence of flagella failed. Otherwise the organism agrees culturally with typical strains, and we believe it to represent a true variant of *B. granulosis*. The other gram-negative rods will be described later by one of us (P. T.) in a bacteriologic study of trachoma.

It has been interesting to note the complete absence of pathogenicity of *B. granulosis* for the lower animals, including the dog, rabbit and

TABLE 4.—*Fermentation Tests of Atypical Gram-Negative Motile Rods* *

	9	11	Z 6	Monkey 10	A. Z.	M 2	M. T.	S
1. Dextrose	++++	++++	++++	++++	++++	—	++++	++++
2. Levulose	—	++++	+++	++++	++++	—	++++	++++
3. Mannose	+++	++++	++++	—	++++	—	++++	++++
4. Saccharose	—	++++	+++	++ (gas)	+++	—	++++	++++
5. Raffinose	—	+	±	—	++	—	—	—
6. Inulin	—	—	—	—	—	—	—	—
7. Galactose	++++	++++	+++	+++ (gas)	+	—	+++	++
8. Maltose	++	++++	++++	+++ (gas)	+++	—	++++	++++
9. Salicin	+	+++	++++	—	+++	—	+++	++
10. Xylose	++++	—	—	++++	±	—	..	—
11. Mannitol	—	++++	++	—	+++	—	++++	++++
12. Dextrin	—	++++	++++	—	+++	—	++++	+++
13. Arabinose	++++	—	+++	+	+	—	—	—
14. Amygdalin	—	—	±	—	(±)	—	—	—
15. Lactose	+	—	+	—	+	—	++++	—
16. Dulcitol	—	—	—	—	—	—	—	—
17. Rhamnose	+	—	+	—	+	—	—	—
18. Trehalose	—	—	+	+	—	—	—	—
19. Sorbitol	—	—	—	—	—	—	—	—
20. Inositol	—	—	—	—	—	—	—	—

* The readings were taken after twenty-one days at room temperature. Test 11 was typical culturally and induced follicle formation in Macacus rhesus 20.

guinea-pig. Rabbits have been able to tolerate large doses of living bacteria intravenously without loss of weight or other symptoms, and massive injections into the anterior chambers of two rabbits' eyes have resulted in no permanent injury and only a slight transient reaction at the time. In marked contradistinction to this are the results obtained after injection into the anterior chamber of two types of small chromogenic gram-negative rods. The first appears to be identical with the chromogenic rod described by Noguchi. In the rabbit eye it produced a severe uveitis which gradually cleared, leaving only a few synechiae as an end-result. The second organism used was slightly larger and highly chromogenic, and had a tendency to bipolar staining. In many respects it resembled the bacterium described by Rosenow and Lewis,[18] and named by them *Flavobacterium ophthalmiae*. Injection of this

18. Rosenow, E. C., and Lewis, F. P.: Periodic Ophthalmia in Solipeds and Its Relation to Uveitis in Man, Tr. Sect. Ophth., A. M. A., 1928, p. 17.

organism produced a severe endophthalmitis, progressing to final atrophy of the globe. The complete absence of pathogenicity of *B. granulosis* for the lower animals is useful in the final identification of suspected strains.

AGGLUTINATION REACTION

Serologic studies are now under way and will be reported in a later communication. We have, however, tested the agglutinative power of the serum of one patient, L. A., from whom we obtained strain 3 and later strain 11. It may be mentioned here that a striking positive skin reaction was obtained in this case after the injection of *B. granulosis* antigen. This patient was chosen especially for serologic studies because of the successful isolation of the organism and also because of the extensive operative work that had been done on her conjunctiva and lids. It seemed to us that agglutinins would be more likely to be present in this patient as a result of dissemination of bacterial products from the operative trauma. However, we were unable to demonstrate agglutination in dilutions as low as 1 : 20.

SKIN TEST

It has been shown that only small amounts of antibodies are present in trachomatous serums and this is only to be expected from analogy with other localized infections. Nevertheless, we had hoped to be able to demonstrate a cutaneous allergic reaction to *B. granulosis* antigen that might be of some value in the diagnosis of the disease. Our reasons for such a hope were (1) the apparent rarity or absence of *B. granulosis* in conditions other than trachoma, and (2) the chronicity and extended duration of the disease, which might conceivably result in a sensitization of the body to *B. granulosis* or its products. Tests in a limited number of cases of trachoma, however, demonstrated the probable presence of an allergy in only one.

Two types of antigen were used. The first was prepared by heating a heavy suspension in physiologic solution of sodium chloride of *B. granulosis* B (Rockefeller Institute strain) in a water-bath at 60 C. for one hour, 0.3 per cent tricresol being added as a preservative. The second antigen was prepared in an identical manner except that five other strains, 1, 2, 5, 6 and 7, were included.

With the first antigen, tests were made on four normal persons, 0.1 cc. being injected into the skin of the upper arm. No reactions were observed either within the first hour or at the end of twenty-four hours. Similarly, tests were made on six trachomatous patients, from four of whom *B. granulosis* had previously been recovered, but all yielded entirely negative results. The second antigen was used in two cases, one of which showed a striking positive reaction appearing at the end

of twenty-four hours, which consisted of a central raised purplish papule surrounded by a marked zone of erythema from 8 to 10 cm. in diameter. The patient complained of a general feeling of malaise associated with a slight rise in temperature, but no swelling or tenderness of the axillary lymph glands. It is interesting to note that this patient, L. A., showed negative agglutination reactions, although *B. granulosis* had been isolated twice and both times had produced follicles in monkeys. The second case and two controls gave negative reactions.

This antigen was also sent to Dr. Polk Richards of the Indian Medical Service, stationed at Albuquerque, who consented to make some tests for us on Indian children. The results of these tests on fifteen

TABLE 5.—*Trachomatous Pupils Given Intradermal Injections of B. Granulosis Antigen*

Girls	Age	Examined in Half Hour	Examined in 24 Hours
Lena Lopez	15	Slightly reddened area 1 inch in diameter	Same
Marion Cawker	14	Slightly reddened area ¾ inch in diameter	Same
Junito Torivio	14	Slightly reddened area 1 inch in diameter	No reaction
Margaret Phillips	16	Slightly reddened area ¾ inch in diameter	No reaction
Lyndall Sckatester	17	Slightly reddened area 1 inch in diameter	No reaction
Lucita Sandoval	16	No reaction	No reaction
Nada Sandoval	14	Small slightly reddened area ½ inch in diameter	Same
Boys			
Paul Aragon	10	No reaction	No reaction
Andrew Lockwood	17	No reaction	No reaction
Joseph Kaytes	13	Marked reddened area 2 inches in diameter	Very slight reaction
Douglas Jahe	15	Slightly reddened small area	No reaction
Vincent Silva	18	Marked reddened area 2 inches in diameter	Very slight reaction
Padro Brown	13	No reaction	No reaction
John Burns	18	Slightly reddened area ¾ inch in diameter	No reaction
Paul Fernando	15	Slightly reddened area ¾ inch in diameter	Very slight reaction
Normal Controls			
Delores Carpio	15	Slightly reddened area ¾ inch in diameter	Same
Sophia Jarmillo	15	Slightly reddened area 1 inch in diameter	Same
Lupe Sarreino	19	Slightly reddened area ¾ inch in diameter	Same
Edna Gunn	19	Slightly reddened area 1 inch in diameter	Same

trachomatous children as well as on four normal persons used as controls are recorded in table 5. They may be considered essentially negative.

EXAMINATION OF SMEARS

Epithelial smears were prepared in all but three of our twenty-nine cases. They were fixed by heat or by absolute alcohol and stained with Giemsa or Lindner's contrast stain. The films were then examined under oil for inclusion bodies and for bacteria that might resemble *B. granulosis.* In patient A. Z., scattered inclusions were found in three different slides prepared at different times. In one of these, fixed by the wet method, small intracellular and extracellular rods with rounded ends, having a distinct morphologic resemblance to *B. granulosis,* were found. A gram stain unfortunately was not made at this time and later smears did not reveal the presence of the organism.

Except for case 8 in table 1, all other smears prepared from white patients with trachoma were negative. It might be mentioned that large rods resembling *C. xerosis* were frequently encountered.

The tarsus removed at operation from patient S. K. was divided into two portions, half being used for cultural purposes and half for sectioning after preliminary fixation in Zenker's solution. Sections were stained by the Gram-Weigert method and also with hematoxylin-eosin, but a careful search failed to reveal the presence of bacteria other than *C. xerosis,* although numerous characteristic trachomatous follicles were present. It will be remembered that Noguchi described the finding of characteristic organisms in films and sections from both human beings and monkeys.

Occasional inclusions were found in the Leupp cases 8, 9 and 11, but they were never numerous. Small rod-shaped micro-organisms corresponding in size to *B. granulosis* were found in four of the cases. We were unable to determine positively whether any of these were intracellular, because of the dry fixation, but some were definitely attached to epithelial cells while others were free. They were never numerous. All seemed to take the form of short rods with rounded ends, corresponding closely to *B. granulosis* in morphology.

Smears were taken at frequent intervals from monkeys 11 and 12. Characteristic bacteria could be found without great difficulty, both in and outside the epithelial cells. In a few instances, clumps of bacteria located close to the nuclei of the cells were found, suggesting at first glance inclusion bodies. What appeared to be typical inclusions, however, were found in one smear from monkey 11, but have not been found on several repeated attempts.

Noguchi described the organism in smears and sections as appearing somewhat thinner and staining less intensely than cultural forms. With one exception the bacteria seen by us have been short and similar to the cultural forms seen in semisolid leptospira medium. In an attempt further to elucidate the subject we injected heavy suspensions of *B. granulosis* into the conjunctivae of four rabbits and two guinea-pigs. Smears were made after forty-eight hour and thirty day intervals, stained with the Giemsa stain, and examined under oil. In the forty-eight hour smears large quantities of bacteria were seen, many apparently phagocytosed by the epithelial cells, but the majority were free. Undegenerated forms retained the short morphology usually seen in culture. In the thirty day smears only small numbers of bacteria were observed, usually located on the epithelial cells. Occasionally a clump of bacteria in a cell was found, producing the effect of a pseudo-inclusion (fig. 3). The majority of the organisms were short with rounded ends, but a small number of longer forms were present.

There is, of course, no way of proving that the bacteria seen in smears are *B. granulosis,* even though the morphology is suggestive. The presence of other gram-negative small rods has been demonstrated by culture both in human beings and in monkeys, and it is possible that some of the organisms described have been these.

FAILURE TO ISOLATE BACTERIUM GRANULOSIS FROM NONTRACHOMATOUS DISEASE

If *B. granulosis* is to be accepted as the cause of trachoma, it is essential that it should not be present in other nontrachomatous diseases of the conjunctiva. On what seems to us to be insufficient grounds, Lindner [10] suggested that the organism was one of the causes of follicu-

Fig. 3 (monkey 11).—Clumps of bacteria (pseudo-inclusions) near the nucleus of an epithelial cell. Reduced from a magnification of 1,480.

lar conjunctivitis. With this in mind we took cultures in all cases of typical folliculosis that have come under our observation, in addition to several cases of advanced vernal catarrh. The technic of culture was the same as that used when known trachoma was being studied. In all, six cases of folliculosis were studied, the material for culture being conjunctival scrapings, although in one case a plentiful supply of follicular material was obtained by expression with forceps while the child was under ether anesthesia incidental to a tonsillectomy. The two cases of vernal conjunctivitis were studied similarly. In none of the cases was *B. granulosis* found, although it may be mentioned that from one case of folliculosis a small motile gram-negative rod was obtained which was similar morphologically to *B. granulosis,* but which could be definitely distinguished by the presence of an intense yellow

pigment in forty-eight hour cultures on agar and also by its atypical sugar fermentations. This organism is the ninth reported in table 4.

Time did not permit as exhaustive a study of this phase as we had desired, but it is our intention to continue the work. It appears to us, however, that our results justify the conclusion that *B. granulosis* is rarely found in diseases other than trachoma and is not, as Lindner suggested, one of the causes of follicular conjunctivitis.

RECOVERY OF BACILLUS GRANULOSIS FROM EXPERIMENTAL TRACHOMA

We attempted the recovery of *B. granulosis* from only two monkeys, 11 and 12. Attempts were not made until the lesions in these animals had apparently reached a maximum in order that the trauma incident to such a procedure should not influence the clinical picture. Instead of removing portions of the conjunctiva as Noguchi had done, we relied on scrapings made with a platinum spatula and on expressions.

Two types of culture medium were used simultaneously, namely, the semisolid leptospira medium and horse or human blood agar containing carbohydrates. We soon discovered that the plates would have to be relied on because the overwhelming contaminations made isolations from the leptospira medium impossible, although a characteristic bacterium was found in smears from this medium on one occasion. The most troublesome contaminants were molds, which rapidly overgrew the plates in several days, before *B. granulosis* had time to develop. Other contaminants were *C. xerosis* and various diphtheroids, hay bacilli, staphylococci sarcinae, and various types of unidentified small motile gram-positive and negative rods which at times resembled *B. granulosis* closely.

Successful isolations were made simultaneously from both animals on the two hundredth day of the disease in monkey 12 and on the ninety-sixth day in monkey 11, only after numerous attempts had been made. Success followed the use of a large number of plates, so that those that were too heavily contaminated could be discarded. The isolated organisms have not yet been tested for pathogenicity, and identification has been made only on the basis of the morphologic and cultural characteristics.

RESULTS OF INOCULATIONS OF BACTERIUM GRANULOSIS INTO THE CONJUNCTIVAE OF MONKEYS

With funds furnished by the Knapp Fund of the Section on Ophthalmology, twenty *Macacus rhesus* monkeys were purchased and used in our experiments. Eighteen of the animals were inoculated. 0.3 cc. of a suspension being introduced into the subconjunctival tissue

of the upper fornix, just above the upper margin of the tarsus. The surfaces of the bulging conjunctiva and the tarsus were then punctured and scratched with the point of the hypodermic needle. In one, monkey 18, a small quantity of the suspension was carefully injected into the subconjunctival tissue of the upper lid in front of the tarsus in addition to the procedure just described. Two monkeys were not inoculated but were placed in cages with animals that had received injections previously and showed well defined monkey trachoma. Following the injection, a slight traumatic reaction occurred, which subsided in a few days in all cases.

The first series was inoculated on May 22, 1929. The group comprised five poorly nourished monkeys. Within two weeks all of them died of generalized tuberculosis before lesions had had time to appear (table 6).

Monkey 7 was first inoculated, May 31, 1929, on the right side, with the Rockefeller strain A. The conjunctiva was normal until Dec. 19, 1929, when congestion and one small granule were seen in the right upper culdesac. The conjunctiva of the uninoculated side was congested. This disappeared before the next examination.

A second inoculation on the same side was made on Jan. 17, 1930, with a mixture of strains Z 1 and Z 7. On March 20, follicles were present in the right culdesac, and the intervening conjunctiva was moderately congested. This progressed, and on April 7, there were congestion and numerous follicles in the right eye and congestion with beginning follicles in the left.

The first inoculation in monkey 8 was made on the right side, on May 31, 1929, with Rockefeller strain A. There was no evidence of change until June 17, when hyperemia and a few small follicles appeared. They remained stationary, and the second inoculation with Rockefeller strain B was made on October 23. Hyperemia of the conjunctiva of the upper culdesac occurred and follicles appeared in both eyes on November 26. The follicles remained small for a short time and then gradually increased in size and number until March 20, 1930. There were marked congestion and numerous large follicles in the uninoculated eye; several small follicles were present in the right eye. Both lower fornices showed small follicles. The disease seemed to be progressing. On April 7, the condition was progressing in the left eye. The follicles bordered the tarsus, but had not invaded it.

The right eye of monkey 9 was inoculated on May 31, 1929, with our strain *B. granulosis* 2. The animal died shortly after, before lesions had developed.

The right eye of monkey 10 (fig. 4) was first inoculated on May 31, 1929. It remained normal until July 9, when the lids became hyperemic. Twenty days later a few small follicles were seen in both eyes; they

TABLE 6.—*Results of Inoculation of B. Granulosis into Macacus Rhesus Monkeys* *

Macacus Rhesus	Inoculation of Cultures: Date	Inoculation of Cultures: Site	Growth from Clinical Case	Results of Inoculations: Inoculated Side: Upper	Results of Inoculations: Inoculated Side: Lower	Results of Inoculations: Side Not Inoculated: Upper	Results of Inoculations: Side Not Inoculated: Lower	Incubation Period	Comment
1	5/22/29	Left upper culdesac	Rockefeller strain A	—	—	—	—	.....	Died within two weeks of inoculation
2	5/22/29	Left upper culdesac	Strain 3.....	—	—	—	—	.....	Died within two weeks of inoculation
3	5/22/29	Right upper culdesac	Strain 3.....	—	—	—	—	.....	Died within two weeks of inoculation
4	5/22/29	Right upper culdesac	Rackefeller strain A	—	—	—	—	.....	Died within two weeks of inoculation
5	5/22/29	Left upper culdesac	Strain 2.....	—	—	—	—	.....	Died within two weeks of inoculation
6	5/31/29	Right upper culdesac	Strain 2.....	—	—	—	—	.....	8/1/29, only hyperemia
7†	5/31/29	Right upper culdesac	†Rockefeller strain A;				—	Questionable because of second inoculation	Double inoculation
	1/17/30	.....	Pooled strains 1 and 7	+ + <	+ —	+ <			
8†	5/31/29 10/23/29	Right upper culdesac	†Rockefeller strain B; strain 3	+ + + <	+	+ + + + <	—	Questionable because of second inoculation	
9	5/31/29	Right upper culdesac	Strain 2.....	—	—	—	—	.....	Died early before lesions developed
10†	5/31/29 10/23/29	Right upper culdesac	Strain 2; strain 7...	+ + + + =	+	+ + + + =	+	Questionable because of second inoculation	See animal protocols; repeated expressions and epithelial smears
11	5/31/29	Right upper culdesac	Strain 3.....	+ + + >	+	+ + + >	+	56 days.....	Regressing but still active 4/7/30 (9 months 7 days after injection); repeated expression and epithelial smears
12†	11/26/29 1/17/30	Right upper culdesac	Strain 6; pooled strains M 2 and M 5	+ + + <	..	+ + + <	..	Questionable because of second inoculation	Inoculated twice; used chromogenic rod in addition to B. granulosis
13	11/26/29	Right upper culdesac	Strain 2.....	—	—	—	—	.....	Died early without lesions
14	11/26/29	Right upper culdesac	Strain 7.....	+ + <	..	+ + <	..	17 days.....	No lesions, 4/7/30
15	11/26/29	Right upper culdesac	Strain 8.....	—	—	—	—	.....	Died one month after inoculation; no lesions
16	12/31/29	Right upper culdesac	Strain 12; pooled strains Z 6, Z 3, Z 2 and P. Z., Jr.	± <	—	±	—	Questionable.....	Suggestive follicles, 4/7/30
17	12/31/29	Left upper culdesac	Strain 13.....	+ >	—	+ >	—	9 days.....	Marked inflammation associated with beginning follicles, but improving 4/7/30
18	2/26/30	Right upper culdesac and tarsus	Strain 11.....	+ + <	..	+ + <	..	30 days.....	Injection not confined to retrotarsal fold but extended to region of tarsal plate
19	.....	Contact; no injection	Contact.....	—	—	—	—	.....	Contact with monkey 11
20	.....	Contact; no injection	Contact.....	+ + <	..	+ + <	..	40 days.....	Contact with monkey 10

* The same technic as that of Noguchi was employed. The meaning of the symbols is as follows: +, few small follicles; ++, follicles larger and more numerous; +++, many follicles with hyperemia and induration of the conjunctiva; ++++, numerous large follicles with hyperemia and marked induration or conjunctiva; <, disease progressing at time of last examination; =, lesions stationary at time of last examination; >, lesions regressing at time of last examination; †, received two inoculations.

disappeared and a second inoculation was done on October 23, with *B. granulosis* strain 7. A striking change was noticed in a week, when many follicles appeared which were irregular in size, several being as large as the largest type seen in severe trachoma in human beings. The interfollicular areas were indurated and hyperemia was marked. The process was confined to the conjunctiva of the fornices. Several small follicles were noticed in the lower culdesac, and the conjunctival vessels were engorged. The severity of the lesions increased gradually. On Jan. 17, 1930, Dr. Edward Jackson examined them and expressed the opinion that their appearance was more suggestive of trachoma than of folliculosis. Later the contents of the follicles were expressed with Prince forceps and transferred to blood agar plates. Epithelial scrapings for smears were taken. As described before, *B. granulosis* was found in cultures and a suggestive rod in smears. On March 20, several follicles bordered the upper margin of the tarsus, and a few minute follicles had developed in the tarsal conjunctiva. Numerous small follicles filled the lower culdesacs of both eyes. The condition was still progressing on April 7. The cornea showed no evidence of change.

Monkey 11 (fig. 6) was inoculated with *B. granulosis* strain 3 on May 31, 1929. The eyes remained normal until July 9, when many follicles were seen in the right eye and a few in the left. The two eyes were equally affected on July 26. There were many large succulent follicles scattered between numerous smaller ones. The interfollicular portion of the culdesacs was markedly congested and indurated. On September 17, the follicles had reached the upper borders of the tarsi, which showed mild papillary hypertrophy in addition to an occasional small follicle. There were small follicles on the semilunar fold. At this time the process had reached its peak, and the severity of the infection gradually subsided. When last examined, on April 7, 1930, the follicles were fewer and smaller, but there was still moderate infiltration of the subconjunctival tissue between the follicles. The corneas were not involved at any time. Epithelial smears were made and expression of the follicles for purposes of culture was done in each eye on several occasions. This manipulation might have been responsible for the improvement shown. Cultures and smears from this animal were positive, and in one instance inclusions were found.

The right eye of monkey 12 was inoculated with *B. granulosis,* strain 6, on Nov. 26, 1929. Both eyes remained normal until December 19, when small follicles were found in both. These gradually subsided, and the right eye was inoculated a second time, on Jan. 13, 1930, with pooled strains from Z 2, Z 3, Z 6 and P. Z., Jr. Small follicles were found in the upper culdesac of each eye. These gradually increased in size and number and when last examined were well developed.

The right eye of monkey 13 was inoculated with *B. granulosis,* strain 2. The animal died soon after injection and before lesions had developed.

The right eye of monkey 14 was inoculated with *B. granulosis,* strain 7, on Nov. 26, 1929. Small follicles were first noticed in both eyes on December 12. The follicles gradually increased in size, and on Jan. 8, 1930, the conjunctiva was definitely indurated. Several small granules were present in the lower culdesac. When the animal was last examined on April 7, the condition was progressing, and several large succulent follicles were present in a hyperemic conjunctiva.

Monkey 15 was inoculated in the right eye with *B. granulosis,* strain B, on Nov. 26, 1929. It died, December 24, before lesions had developed.

The right eye of monkey 16 was inoculated with *B. granulosis,* strain 12, on Dec. 31, 1929. Two small follicles appeared in the right eye and one in the left on April 7, 1930, and the conjunctivae of both upper culdesacs were deeply congested.

Monkey 17 was inoculated in the left eye with *B. granulosis,* strain L 13, on Dec. 31, 1929. Marked congestion and slight folliculosis with conjunctivitis were observed on Jan. 13, 1930. These symptoms subsided and, when last examined, on April 7, both eyes were normal.

The right culdesac and subconjunctival tissue in front of the tarsal plate of monkey 18 were inoculated on Feb. 26, 1930, with *B. granulosis,* strain 11. Marked congestion of the upper culdesac and beginning follicles in each eye were observed on March 26. When the animal was last examined, on April 7, the disease had progressed, and a moderate papillary hypertrophy of the conjunctiva over the tarsus of the right eye was present.

Monkey 19 (Jakko) was in contact with monkey 11 from Dec. 15, 1929, to April 7, 1930. The conjunctiva remained normal.

Monkey 20 was in contact with monkey 10 for forty days. Congestion and well developed follicles appeared first in the right upper culdesac. Those in the left eye were more advanced. The follicles are identical with those that occurred in the early stage of the more severe cases in inoculated monkeys.

The results of inoculation of *B. granulosis* into *Macacus rhesus* monkeys are recorded in table 6.

An analysis of the protocols and tables reveals the following facts: The incubation period in our series varied from seventeen to ninety-seven days. However, in one animal, monkey 10, follicles appeared seven days after a second inoculation.

With the exclusion of eight animals that died shortly after inoculation, granules developed in all of the inoculated monkeys.

Fig. 4 (Macacus rhesus 10).—Lesions in right and left eyes three and one-half months after inoculation.

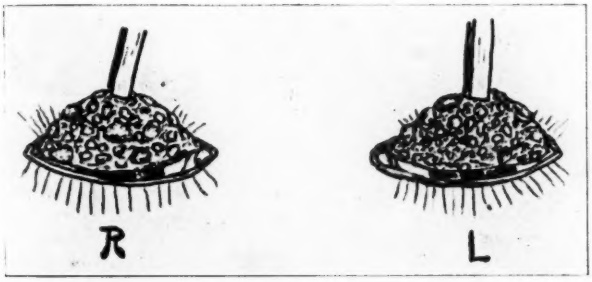

Fig. 5.—Lesions in Macacus rhesus 10, Feb. 12, 1930. Compare with figure 4.

Fig. 6 (Macacus rhesus 11).—Lesions in right and left eyes seven months after inoculation.

In eight of the remaining animals inoculated with *B. granulosis,* folliculosis and other changes that occur in human trachoma developed, and one of the two contacts exposed to monkeys with active lesions contracted the disease.

In six animals the lesions were progressing at the time of the last examination and in one the disease was stationary. In two the lesions had regressed. The regression in monkey 11 might be attributed to repeated expression and scraping of the surface of the conjunctiva.

In monkeys 10 and 11, slight evidence of scar tissue was present; this might have been caused by mechanical manipulation, as scarring did not occur in our other animals.

Lesions appeared on the inoculated side in every animal that survived, and, with the exception of monkeys 7 and 8, the process was as severe in the untouched eye as it was on the side that had received the inoculation. In monkey 8 the follicles were more numerous on the uninoculated side, and in monkey 7 they were fewer.

Lesions appeared in the two eyes simultaneously, but in some instances they were more severe in the inoculated eye at the time of onset. At a later period the two eyes became equally involved. In monkey 8, however, the appearance was more striking on the untouched side in the early stage.

In all cases the granules were more numerous in the upper retrotarsal fold than in the lower. In the lower fold the follicles were smaller and resembled the type that occurs in follicular conjunctivitis in man. They contrasted strikingly with the advanced lesions in the upper lid, which closely resembled the granules of trachoma. The interfollicular areas showed infiltration above but none below.

The semilunar fold showed a few transient follicles in monkey 10, but this feature was not conspicuous. The caruncle resisted infection in all cases.

In several of the positive cases a mild purulent secretion was noticed in the early stage just before the appearance of follicles. Marked hyperemia of the conjunctiva was always present when secretion was noticeable.

EXPERIMENTAL TRACHOMA IN MONKEYS

Hess and Romer,[19] Morax,[20] Nicolle, Cuénod and Blaizot,[21] Wilson [22] and a number of others have successfully inoculated the conjunctiva of

19. Hess and Romer: Arch. f. Augenh. **55**:1, 1906.

20. Morax, V.: Ann. d'ocul. **145**:414, 1911.

21. Nicolle, C.; Cuénod, A., and Blaizot, L.: Compt. rend. Acad. d. sc. **152**:1504, 1911; **155**:241, 1912; **156**:1177, 1913; Arch. de l'Inst. Pasteur, Tunis, 1911, p. 185; 1913, p. 157. Nicolle, C., and Lombroso, U.: ibid. **15**:240, 1926.

22. Wilson, R. P.: Nouvelles notes sur le problem étiopathologique du trachome, Rev. internat. du trachome **5**:76 (April) 1929.

monkeys with trachomatous material obtained from the eyes of human beings. The lesions that developed, however, were confined to the conjunctiva of the retrotarsal fold and the tarsal portion of the lids. The cornea remained unaffected with few exceptions (Nicolle saw keratitis) and pannus never occurred. The disease was never as severe as in the human being, scar formation was inconspicuous, and ectropion was never observed. Trachoma in monkeys, therefore, is similar to that in human beings only in the stage of granulation. It is characterized by the formation of follicles in the conjunctiva of the lids and retrotarsal fold and by mild scar tissue formation. It can be transferred from monkey to monkey by transplanting diseased membrane to the conjunctiva of healthy animals. Experiments on animals are, in consequence of this, of limited value. In the light of our present knowledge of trachoma we can only conclude that the formation of severe follicular conjunctivitis with induration between the follicles and slight scar tissue formation in the late stage is characteristic of monkey trachoma. When this occurs in monkeys after the injection of material that has been obtained from trachomatous patients, monkey trachoma is produced. In other words, it is difficult to prove with monkeys that one has reproduced human trachoma. This is especially true in the light of the investigations of Wilson [22] of the Giza Memorial Ophthalmic Hospital of Cairo, and of Nicolle and Lombroso, who found spontaneous folliculosis in healthy monkeys that had not been exposed to trachoma. However, the condition which they described is apparently much less severe than the disease produced by the implantation of human trachomatous material or the injection of *B. granulosis*. We may mention here that all of our animals were carefully examined before inoculation to exclude spontaneous folliculosis.

In comparing our results after the injection of *B. granulosis* into the conjunctivae of *Macacus rhesus* monkeys with those that have been described in animals inoculated with trachomatous material, we are justified in concluding that four of our monkeys had manifestations characteristic of monkey trachoma. In monkeys 8, 10, 11 and 12, the granules were larger and more irregular in shape and distribution, in addition to being more succulent, than the type of follicle that is seen in human follicular conjunctivitis. When squeezed, a large quantity of gelatinous lymphoid material exuded from the follicle. This substance was of precisely the same character as that which can be expressed from the follicles in human trachoma.

CONCLUSIONS

1. A minute gram-negative motile rod, apparently identical with that described by Noguchi under the name of *Bacterium granulosis,* has been recovered from five of thirteen white persons, and from one Japanese

with advanced trachoma. The objections raised by Lindner regarding the original Indian cases studied by Noguchi cannot be applied to our cases because of the presence of pannus and advanced scarring in all but two cases. *Bacterium granulosis* was recovered also from two of fourteen trachomatous Indian children studied.

2. The bacterium is either rare or absent in nontrachomatous diseases of the conjunctiva.

3. *Bacterium granulosis* may be considered more characteristic of trachoma than the inclusion bodies of Prowazek or the initial bodies of Lindner, since it can be recovered from patients having advanced disease at a time when the inclusion bodies and initial bodies are usually absent.

4. The probable reason for the failure of former investigators to discover the organism lay in their use of unsuitable mediums and their failure to cultivate at the optimal temperature of 30 C.

5. The bacterium was not agglutinated by serum that was tried from a single case of trachoma.

6. Skin tests with *B. granulosis* antigen have been uniformly negative, with one exception.

7. Bacteria morphologically identical with *B. granulosis* have been seen on and in the epithelial cells in smears taken from trachomatous patients and from animals having the experimental disease.

8. Inoculation of *Macacus rhesus* monkeys with suspensions of *B. granulosis* has resulted in the production of a granular conjunctivitis identical with that described by Noguchi and also with that resulting from the injection of human trachomatous material.

9. Contact infection occurred in one of two monkeys exposed.

10. The bacterium has been successfully recovered from two animals having an advanced disease.

11. Our results would seem to confirm those of Noguchi in all essential respects.

12. Because of the fact that trachoma in monkeys is not identical with that in human beings, it may be necessary to resort to human inoculations to prove or disprove conclusively the etiologic relationship of *Bacterium granulosis* to trachoma.

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ABSTRACT OF DISCUSSION

DR. PETER K. OLITSKY, New York: The observations recorded by Drs. Finnoff and Thygeson are extremely interesting and important. Their results are in entire agreement with those obtained at the Rockefeller Institute by Tilden and Tyler, who have carried on one of Noguchi's strains of *Bacterium granulosis* in monkeys, have recovered the organism from the experimental lesions of monkeys and have isolated additional strains from cases of trachoma in Indians.

I should like to call attention to a fact which was emphasized by the authors, namely, the sensitiveness of *B. granulosis* to cocaine, even in low concentrations, and, on the other hand, its resistance to procaine hydrochloride in higher concentrations.

Since cocainization of the eye is still a common practice, and solutions of 5 and 10 per cent cocaine are often employed for this purpose, it is possible that some of the negative results of culture experiments reported by some workers may have been due to the use of strong cocaine solutions.

There is a certain agreement among ophthalmologists that trachoma, as it occurs among the white persons of the United States, is identical with the disease prevalent in the remainder of the world. It is therefore significant that *B. granulosis* was recovered from white persons first by Drs. Finnoff and Thygeson in Denver, then by Olitsky and Tyler in New York, and recently by Kendall in Chicago.

In New York we have been able to induce the experimental disease in monkeys by repeated swabbing, and also by a single injection of the conjunctivae with suspensions of trachomatous human tissues. Furthermore, *B. granulosis* has been recovered not only from the human material inoculated into monkeys but also from the conjunctivae of a monkey so affected.

We have not seen the spontaneous disease develop in any monkey during prolonged observation. We have found that in certain dealers' stocks a varying number of simians are affected. Recently more than 250 monkeys were examined at the dealers and none with spontaneous folliculosis were discovered. The problem of spontaneous folliculosis in monkeys is receiving our attention now and thus far we may say that *B. granulosis* has not been recovered from the conjunctivae of such animals, nor is cross-immunity present between spontaneous folliculosis and experimental granulosis conjunctivitis.

Dr. Solomon Reina, Los Angeles: I observed several cases in which the wearing of a misfitting prosthesis for several years after enucleation produced a typical trachoma with cicatrices, while the fellow eye was normal. Is the etiologic factor here *B. granulosis* or chronic irritation? In the Near East, where the incidence of trachoma is large, I not infrequently observed unilateral trachoma. Trachoma in the orient develops in the large majority of cases in this manner: An infant or a child has an attack of acute ophthalmia during the epidemics occurring yearly in the summer and early fall. We treat hundreds of patients with suppurative conjunctivitis during these epidemics, thus checking the suppuration. As the result of poverty and neglect, the patients discontinue treatment as soon as amelioration occurs, while the fire remains slumbering in a subacute or chronic form until the following hot summer season, when another attack occurs. If these patients are examined carefully after two or three such attacks occurring over a period of two or three years, granular and papillary forms of trachoma will be observed. The micro-organisms found in the secretion during these attacks of acute conjunctivitis are the gonococcus, pneumococcus, Morax-Axenfeld diplobacillus or Koch-Weeks bacillus. The gonococcus is transmitted from eye to eye without any connection with the urethra. I am inclined to think that the toxins of organisms—*B. granulosis* may be included—as well as irritation from a foreign body such as that of a prosthesis, when allowed to act for a long time on the conjunctiva, produce a form of granulation tissue or proliferation of the epithelial and adenoid tissue of the conjunctiva to repair the damage done to the cells. Though the work of the authors is invaluable and fascinating, yet to convince myself of the analogy between lesions produced in monkeys by *B. granulosis* and human genuine trachoma, I would submit the

monkey's conjunctiva thus infected to the influence of caustics for a few days. If after such treatment the follicles are not effaced, I should call it quasitrachoma. I apply this test to suspicious cases in human beings. If the condition clears up after two or three applications of silver nitrate solution, I pronounce it negative for trachoma.

DR. EDWARD JACKSON, Denver: Some will be influenced by the clinical appearance and manifestations of these animals, as well as by the strict conformity to bacteriologic requirements. I saw the monkeys that were experimented on in this study. I am not acquainted with diseases of the conjunctiva in monkeys, in general, or with the folliculosis said to occur in them. But this disease in the conjunctivae of monkeys looks more like trachoma, as it is known in the human eye, than any other disease I have seen. The granulations and the course of the disease in the eye of the monkey are closer to trachoma than to any other disease I know of in the human conjunctiva. Dr. Olitsky referred to the occurrence by contact and the inoculation by *B. granulosis* in one eye, followed by this disease in the other eye of the same monkey. These features it has in common with trachoma. The appearance of these lesions from month to month, their slow progress, the slow involvement of tissue by advancing granulation, and the slow recovery, are much as in trachoma in the human eye. A young man had what was recognized as acute trachoma. Within six months one eye had recovered entirely. It had never shown any typical trachoma granules. The other eye showed the disease for a year and a half, with typical granulations over the tarsus. There is no evidence to show that with inoculation by trachomatous material or by the Noguchi bacillus pannus is likely to occur in monkeys. In these monkeys no evidence of pannus was seen, although there was a suspicious appearance at the margin of the cornea in two or three of them. It is fair to dwell on these clinical aspects of what appears to be a specific disease in the eyes of monkeys, clearly produced by *B. granulosis*, in order to get for it a fair hearing before clinicians who deal daily with trachoma.

DR. WILLIAM H. WILDER, Chicago: It is significant that Dr. Finnoff and Dr. Thygeson have been able to obtain results similar to those obtained by Noguchi. There has been failure on the part of others to confirm that work, possibly because *B. granulosis* seems to be affected by cocaine solutions that might have been used for anesthesia when the experiments were conducted, and partly because of differences of technic in the methods of transmission. I have had the opportunity of seeing many of the animals in the Rockefeller Institute, but I have not seen those that have been experimented on by Drs. Finnoff and Thygeson. When I had the opportunity of examining the monkeys and apes inoculated by Noguchi it seemed to me that the lesions of the conjunctiva simulated closely those that one sees in trachomatous eyes of man, although in milder degree. In the chimpanzee and the orang-utan the disease seemed to be more marked than in the *rhesus* monkeys. One essential feature of genuine trachoma, viz., the formation of new connective tissue (scar tissue) in the conjunctiva and tarsus, seems to have been demonstrated in the disease as it is produced in monkeys. Naturally, this is seen more abundantly in the later stages of the disease. When visiting Dr. Noguchi, and again last winter at the Rockefeller Institute, I had the opportunity of studying some slides; it seemed to me that the new connective tissue shown in the sections was of the nature of fibrous scar tissue. Some clinical authorities insist that trachoma cannot be diagnosed until pannus is shown. I cannot agree with that view. It has been my opportunity to see a great deal of trachoma in all stages and in all classes of people, and I know

there must be a time when they have trachoma, before pannus develops, that it is possible to make the diagnosis. It is in the later stages—I am speaking clinically—when the disease has extended to the ocular conjunctiva, that pannus develops. It occurs probably in two ways: one by the actual extension of the disease from the bulbar conjunctiva to the cornea, and the other by the irritation of the cornea from the rubbing over it of the roughened tarsal conjunctiva. Long before this happens, if one is familiar with the disease, one should be able to make the clinical diagnosis of trachoma and to institute proper treatment. Another point that might be raised in argument against the necessity of pannus occurring in these experimental animals is this: It may be that the eyes of monkeys are much less sensitive to the infection than are the eyes of man. So far as is known, the experimenters have not produced any very virulent cases of acute trachoma such as are sometimes seen in man. However, this is no proof that the condition produced is folliculosis and not real trachoma.

Dr. J. W. Jervey, Greenville, S. C.: In order to establish a fact by experiment one must first be absolutely certain of the effect which he produces or which he desires to produce. There is undoubtedly a great deal of disagreement among the ophthalmologists of this country as to what does or does not constitute true trachoma. I belong to the old school which was taught something about trachoma in the last years of the last century; it was not unusual to see fifty or sixty cases a day in the dispensaries of New York. Since restricted immigration has been in force, these cases have not been seen. I believe that trachoma cannot be diagnosticated positively until there is a true papillary hypertrophy, not a follicular hypertrophy, until there is characteristic cicatrical tissue following hypertrophy and until, finally, pannus appears. By pannus I do not mean a little superficial vascularization of the cornea; I mean that which shows as a direct involvement of Bowman's membrane. While there may be a case of trachoma that does not show pannus, as Dr. Wilder said, still when that case advances to a point at which absolute diagnosis can be made, it will show some signs of pannus. The same might be said of the cicatricial appearance of the conjunctiva. And this is true to such an extent that Axenfeld made the suggestion years ago that the name trachoma be dropped and the term cicatricial conjunctivitis be substituted for it. I feel, therefore, that unless and until some organism or some agent can be identified as the causative factor that will produce these characteristic changes, the cause of trachoma will not have been demonstrated. About twenty-five or thirty organisms are known to cause follicular congestion in the conjunctiva, that is, merely hypertrophy of the adenoid layer of the conjunctiva, in a patient with lymphatic diathesis; chemical insult, mechanical insult or refractive error will also cause follicular hypertrophy of the conjunctiva. Is it not possible that these animals on which Dr. Noguchi and Drs. Finnoff and Thygeson have been experimenting may show, after all, only another one of these organisms, it being remembered at the same time that in all probability the early stages of trachoma cannot be differentiated from follicular hypertrophy? The later development of the individual case, the epidemiology and the characteristic appearances which I have just described will eventually establish the diagnosis.

Dr. F. H. Verhoeff, Boston: About the time Dr. Noguchi had completed his first work on this subject, a group of ophthalmologists, of whom I was one, visited his laboratory. He showed us all his animals and described his work. I think that about that time he presented his work at a meeting in New York. At that time I expressed the opinion, and I think all who saw his results concurred in it, that as the result of his work the burden of proof rested on any one who

claimed that the organism which he had discovered was not the cause of trachoma. I think the work of Drs. Finnoff and Thygeson has made this burden much greater, and I feel convinced that the organism they are dealing with is the cause of trachoma. I do not think it is necessary to produce in monkeys exactly the same thing as trachoma. Of course, it is possible that monkeys are so resistant to the disease that they react differently. The terms follicular conjunctivitis and folliculosis have become confused, possibly because the term folliculosis was used in the first place to describe follicular conjunctivitis. Many years ago Saemisch published a description of what he called folliculosis, and I think he was the first to call attention to that disease. He ignored the fact that this term had been used for follicular conjunctivitis. Folliculosis, as he used it, meant simply lymphoid hypertrophy of the conjunctiva, such as is seen associated with adenoids or enlarged lypmh glands in children. It is very common and in past years its occurrence caused many supposed epidemics of trachoma in schools. Dr. Jervey was one of the first to point out this fact. I think that folliculosis can be told histologically from trachoma in a majority of cases. In folliculosis the follicles may be very large, or they may be small, but it will be found on study of the section as a whole that the follicles are separated from the epithelium, and that there is a little connective tissue between the follicle and the epithelium. One might speak of them as being encapsulated. If one tries to express the follicle of folliculosis it will be found to be difficult, whereas in trachoma it is easy.

DR. MARTIN COHEN, New York: I had an opportunity to discuss Dr. Noguchi's paper presented at the section meeting several years ago at Washington. I stated at that time that the monkeys, which were inoculated with *Micrococcus granulosis,* isolated from human trachoma, produced a follicular conjunctivitis. I based this opinion on the observation of the monkeys' conjunctiva after several months. My intimacy with the study of trachoma and allied conditions covers several years' service in hospitals in which trachoma and allied conditions were mainly treated. I had been able to observe cases from their early to their final stage. Such experience is essential in order to diagnose a case when seen at any period in the course of the disease. To diagnose borderline cases or cases of mixed infection, one is required to wait until acute symptoms have subsided, when the underlying clinical picture becomes evident. To diagnose trachoma in animals, one must have a complete knowledge of the course of the disease in animals and human beings, in order to make a clinical comparison. My conception of follicular conjunctivitis is that it is a condition due to a lymphoid infiltration, first of the fornix of the lower conjunctiva which passes over the globe to invade the upper fornix. This lymphoid infiltration produces follicles or granules of varying size and quantity, which after several months or years resorb first from the upper fornix and then from the lower fornix, leaving the conjunctiva normal. The quantity, size and location of follicles is not, I believe, the differential factor between follicular conjunctivitis and trachoma. In trachoma, in the early stage, one finds follicles in the fornix associated with a definite papillary hypertrophy of the conjunctiva which invades the tarsus, first of the lower lid and then the upper lid. This papillary hypertrophy, after several months, results in atrophy with cicatrization of the conjunctiva and tarsus. Frequently cicatrization of the cornea occurs with pannus. It has been said, "Once trachoma always trachoma." I believe this statement to be a clinical fact according to the accepted definition of trachoma. As regards the conjunctivitis produced in the monkeys, after several years' observation I would say that we are dealing with a follicular conjunctivitis, caused by the *Micrococcus granulosis* of Noguchi, which was pro-

cured from cases of true trachoma. Definite conclusion, with respect to the etiologic cause of trachoma requires a still longer period of observation of the inoculated animals for evidences of conjunctival and corneal cicatrization or conjunctival cicatrization solely. Until that time arrives, I believe, a definite conclusion must be held in abeyance.

Dr. William H. Crisp, Denver: I have had the privilege on several occasions of looking at the conjunctivae of these experimental animals with Dr. Thygeson. There has been undeniable follicular conjunctivitis, and in some of the animals more recently a definite invasion of the tarsal area of the upper lid. The ultimate conclusion may possibly be that *Bacterium granulosis* is a cause of the symptom complex which is called trachoma. I have not done any research along this line. Many years ago in the Denver clinic we used to see a relatively large number of cases among the Russian Jews. Not nearly so much trachoma appears there now. I have had considerable acquaintance for many years with the literature dealing with research work on trachoma, and I am particularly impressed with the fact that even clinically some of the men in Europe who see the greatest amount of trachoma do not agree as to which cases are trachoma. Some of them lean in the direction of saying that the kind of case that most ophthalmologists would call folliculosis was trachoma without the late changes; others would not go that far. I do not see that there is any fundamentally good reason for saying that no case can be trachoma unless it shows the late corneal changes. One might as well say that no case is tuberculosis of the lung unless there is cavity formation. Why not admit the probability that many patients have the disease and recover before it gets to the late stage? I cannot escape the feeling that what is called trachoma is probably a symptom complex of chronic irritation in the conjunctiva and the underlying tissues, but that this symptom complex in almost indistinguishable forms may be due to a variety of causes. I have often referred to a case I had a number of years ago, the diagnosis of which was confirmed by several leading ophthalmologists, and which showed advanced pannus, but which was entirely relieved in a short time after complete occlusion of the left nostril from early injury had been remedied and free drainage established on that side of the nose. Several years ago, I also had two cases with definite trachoma, including pannus, which cleared up after the removal of focal infections in the teeth and tonsils.

Dr. Allen Greenwood, Boston: Dr. Cohen and Dr. Crisp have said just what I intended to say. With all due respect to Dr. Jervey's opinions, I recognize the difficulty that he has labored under in his home state, where most of his confrères are curing trachoma when it is only folliculosis. But I do not want to add my opinion to the two gentlemen who have preceded me. Pannus, as Dr. Jervey described it, is not necessary for the diagnosis of trachoma in the human being; that is, the pannus that he describes.

Dr. Laura A. Lane, Minneapolis: The use of the slit-lamp has not been mentioned in the early diagnosis of trachoma. French workers—Cuénod and Nataf, and Morax—have reported on it. In this country there is not much opportunity to see many early cases. I have followed cases for several years and I believe there is something in the vascular pattern not only of the ocular but of the palpebral conjunctiva, as seen by biomicroscopy, which differs from other conjunctival diseases. I wish those who have slit-lamps would observe their cases of trachoma from time to time, likewise those doing experimental work on trachoma in animals, and see whether they can verify this point, namely, that there is a change in the vascular pattern which is of help in making a diagnosis.

DR. PHILLIPS THYGESON, Denver: One point that was not brought out and which I believe to be of importance is the absence of *B. granulosis* in nontrachomatous conjunctival disease. In our paper we reported taking cultures of six cases of follicular conjunctivitis with negative results, and since then we have taken cultures of three more, using the same technic and the same care as in the original trachoma cultures. This is of significance in considering monkey trachoma, as the recovery of *B. granulosis* from the lesions in animals would seem to add additional support to our belief that the experimental disease is true trachoma rather than a follicular conjunctivitis. Another point I wish to emphasize is that we have recovered *B. granulosis* from a monkey infected by contact. This is of importance in ruling out the possibility of spontaneous folliculosis, as Dr. Olitsky has reported the absence of *B. granulosis* in that condition. Although two of our animals now show slight scar tissue formation, both have been subjected to repeated scrapings for cultural purposes and we are unable to say that the scarring has not resulted from the consequent trauma. The disease in monkeys shows a marked tendency to variation in intensity. There may be quiescent periods of several weeks or months followed by acute flare-ups lasting variable periods of time. The resemblance to the human disease is marked. As so much reliance has to be placed on the experimental disease, it is unfortunate that we were unable to use the chimpanzee, an animal in which the lesions most closely resemble those in man. The cost of these animals, however, is prohibitive. Dr. Jervey spoke of papillary hypertrophy. Most of our animals have shown this condition, which has been especially marked over the tarsal conjunctiva. Our animals are now showing lesions considerably more advanced than shown in the illustrations. There is considerable involvement of the upper tarsus with follicles scattered also over the bulbar conjunctiva.

CHIASMAL SYNDROME PRODUCED BY CHRONIC LOCAL ARACHNOIDITIS

REPORT OF EIGHT CASES *

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As chronic local arachnoiditis has been regarded by some as a questionable condition, and has been suspected of being secondary to an adjacent tumor, we are reporting eight cases, three of which came to necropsy, to aid in counteracting this impression. The differential diagnosis was extremely difficult in some of the cases, but the postoperative visual improvement was sufficient to justify surgical procedures as a routine.

Inflammatory lesions about the chiasm have been termed prechiasmal cisternal arachnoiditis,[1] chronic local arachnoiditis [2] and circumscribed arachnoid inflammation of the chiasm.[3]

CHIASMAL GROUP

The ocular syndromes produced by lesions at or near the optic chiasm have been well classified by Cushing,[4] who enumerated seven possible causes: (1) meningiomas with a parasellar, rather than a suprasellar, point of origin; (2) pituitary adenomas; (3) congenital tumors arising from the craniopharyngeal pouch; (4) gliomas arising from the chiasm or the third ventricle; (5) chronic local arachnoiditis; (6) syphilitic meningitis, and (7) aneurysm. Any one of these may affect the optic nerves, chiasm and either or both optic tracts in varied combinations, producing definite ophthalmologic changes. The usual changes are summarized as: (1) lowered central visual acuity; (2)

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* From the Section on Neurologic Surgery and the Section on Ophthalmology, the Mayo Clinic.

1. Bassoe, Peter: Nervous and Mental Diseases; Practical Medicine Series. Chicago, Year Book Publishers, 1929, 417 pp.

2. Cushing, Harvey; and Eisenhardt, Louise: Prechiasmal Cisternal Arachnoiditis: Meningiomas Arising from the Tuberculum Sellae, Arch. Ophth. **1**:168 (Feb.) 1929.

3. Balado, M., and Satanowsky, P., quoted by Bassoe (footnote 1).

4. Cushing, Harvey: Chiasmal Syndrome, Arch. Ophth. **3**:505 (May) and 704 (June) 1930.

pale optic disks, or simple optic atrophy; (3) bitemporal hemianopia for colors; (4) bilateral hemianopia for form and colors; (5) bitemporal scotomatous hemianopia for colors or form or both; (6) temporal hemianopia with amaurosis of the opposite side; (7) temporal hemianopia with successive changes which lead to amaurosis, such as central scotoma, cecocentral scotoma, enlargement of the scotoma with islets of vision and amaurosis; (8) homonymous hemianopic scotoma for form and colors; (9) homonymous hemianopia for colors, and (10) homonymous hemianopia for form and colors.

A significant feature of the defects in the visual field produced by chiasmal lesions is the asymmetry, whether bitemporal or homonymous, in contrast to the symmetric defects produced by lesions affecting the optic tracts or radiations.

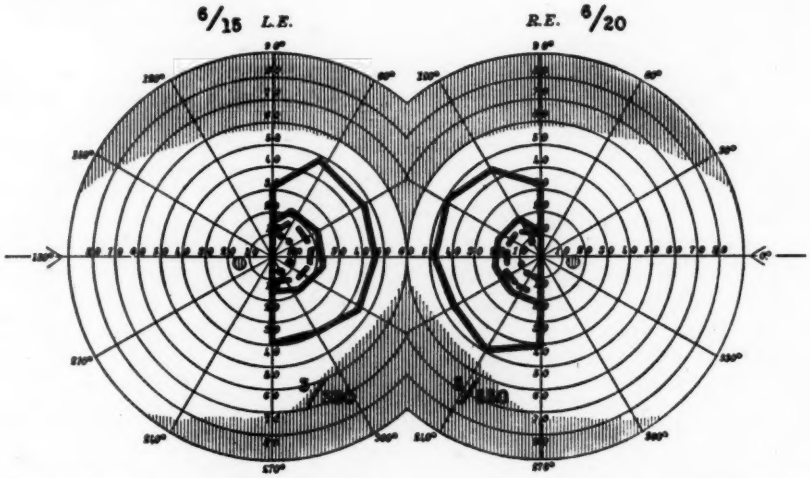

Fig. 1 (case 1).—Perimetric fields showing definite symmetric bitemporal hemianopia for form and colors with diminution of central visual acuity. The fundi were normal.

Case 1.—A man, aged 36, came to the clinic complaining of failing vision and headaches. He had been well until eight months previously, when he noticed that his vision was becoming blurred at the outer half of both eyes. Three months later, he began to have intense headaches daily for about five weeks, which then occurred two or three times a week with less severity. For two months prior to registration, he had had polydipsia and polyuria; he had gained about 25 pounds (11.3 Kg.) in weight, and had become very weak, with increasing drowsiness.

The systolic blood pressure was 100, the diastolic 80; the pulse rate was 72, and the temperature was normal. The specific gravity of the urine was 1.010; it was acid in reaction and did not contain albumin, sugar or pus. The hemoglobin was 77 per cent. The erythrocytes numbered 4,440,000, and the leukocytes 8,900. The Wassermann reaction of the blood was negative. A roentgenogram of the head disclosed a normal sella turcica without evidence of abnormal shadows. The basal metabolic rate on three successive examinations was —5, —4 and —9 per cent.

Ophthalmologic examination revealed the vision to be 6/20 in the right eye and 6/15 in the left eye; the pupils and reflexes were normal; the perimetric fields showed bitemporal hemianopia for form and colors. The fundi were normal (fig. 1). The results of the neurologic examination were essentially negative, except for the ocular changes.

Because of the polyuria and polydipsia, and the fact that the fluid intake was 5 liters a day, with a similar output, the patient was placed on treatment consisting of 1 cc. of pituitary extract a day, which resulted in a decrease to about 2 liters of fluid a day. In view of the fact that examination revealed bitemporal hemianopia, with diminution of vision in each eye, as well as diabetes insipidus with obesity, a provisional diagnosis was made of chiasmal lesion, and because of a definite history of progression, exploration of the optic chiasm was recommended. The patient returned home under treatment for the diabetes insipidus and came back for operation after three weeks, at which time his general condition was definitely improved.

At operation, the optic chiasm was observed by means of right transfrontal exploration. The optic nerves were found to be sheathed by an opaque membrane which involved the chiasm and extended to the anterior clinoid process. On incising this membrane, there was an escape of cerebrospinal fluid, and the membrane was dissected from the optic nerves. The left optic nerve was apparently more involved than the right. After liberation of the nerves and chiasm by blunt dissection, the wound was closed.

Following an uneventful convalescence, the patient continued to show evidence of diabetes insipidus by maintaining a high fluid intake and output, in spite of further treatment. After his return home, his condition was stationary for a time but gradually declined, and death occurred five months after the operation.

Because of the discouraging results following operative procedures and the inability to confirm the operative diagnosis by postmortem examination, this case was classified as questionable chronic local arachnoiditis.

CASE 2.—A man, aged 32, reported at the clinic because of headaches and dimness of vision. He had been well until six months previous to examination at which time bilateral temporal headache developed; this increased in severity and became more intense in the morning. There was never any associated nausea or vomiting. Shortly after the onset of headache, the patient noticed intermittent diplopia and also gradual enlargement of the hands and feet with coarseness of features. An increase of 62 pounds (28.1 Kg.) in weight had occurred during the previous few years.

The systolic blood pressure was 125, the diastolic 80; the pulse rate was 72, and the temperature was normal. The specific gravity of the urine was 1.235; it was acid in reaction, and contained a slight amount of albumin and a slight amount of pus with 6 cells to the microscopic field. The hemoglobin was 80 per cent; the erythrocytes numbered 4,540,000, and the leukocytes 7,100. The Wassermann reaction of the blood was negative. A roentgenogram of the head did not reveal any change of the sella turcica or abnormal shadows near the chiasm. The basal metabolic rate was —10 per cent. Ophthalmologic examination revealed the vision to be 6/7 in the right eye, and 6/10 in the left eye; the left pupil was larger than the right, and there was horizontal nystagmus to the right. Examination of the perimetric field disclosed bitemporal hemianopia for colors with concentric contraction of the form field. The fundi were normal (fig. 2). Neurologic examination gave negative results except for structural changes of acromegalic type.

Taking into account the headaches, early signs of acromegaly and bitemporal hemianopia, with negative roentgenograms, a diagnosis of chiasmal lesion was made, and right transfrontal exploration was advised. At operation, the optic chiasm was exposed, and definite adhesions were found about the chiasm which involved it and the surrounding structures. There was no evidence of neoplasm arising in the hypophysis or from the arachnoid.

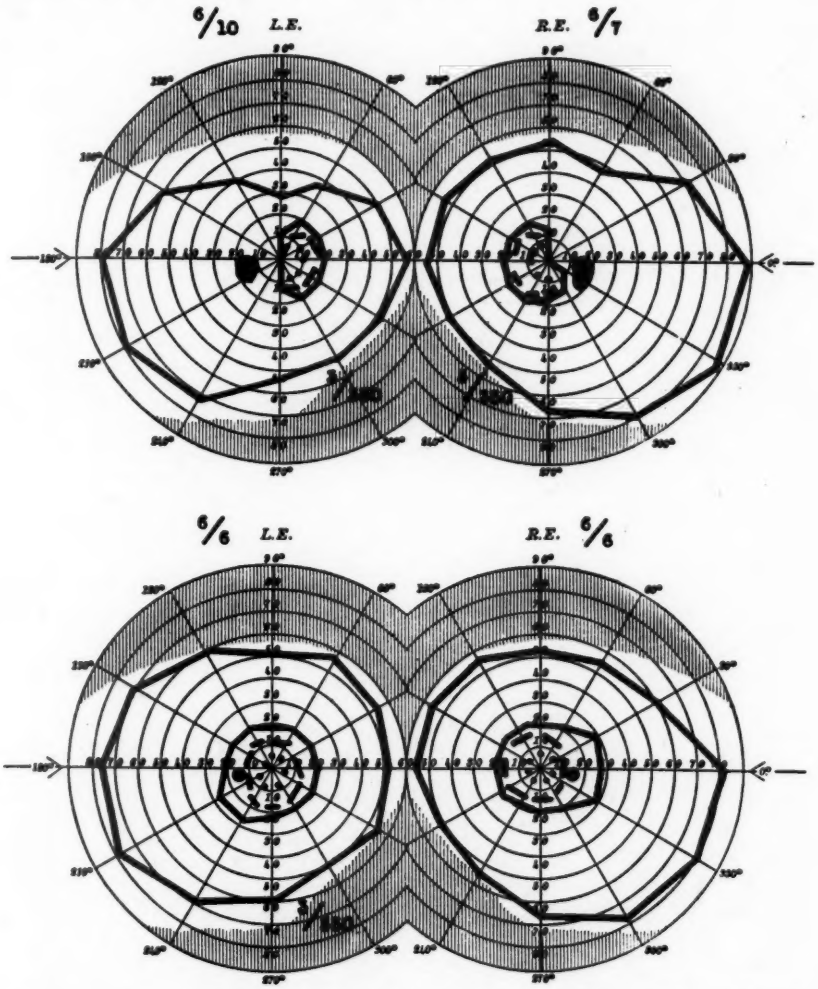

Fig. 2 (case 2).—Perimetric fields showing definite bitemporal hemianopia for colors with enlargement of the blind spots. The central visual acuity was slightly impaired. Following operation (shown in the lower figure) the color fields improved temporally in each eye, and the central visual acuity returned to normal in each eye. The fundi were normal before and after operation.

After an uneventful convalescence, the patient was dismissed from observation. There had been some change in the visual fields for colors, but the headaches had been completely relieved. Two months after the patient's return home, the visual fields had returned to normal, and he was working every day; he reported his condition as excellent.

Case 3.—A man, aged 46, complained of dimness and blurring of vision. Six months previously, an abscess of one of the lower right molar teeth developed, and the face became swollen and painful. A dentist lanced the abscess, which drained; it had to be reopened two days later. Within a few hours after the second drainage, the patient began to experience severe pain behind both eyes, associated with dimness of vision. In a few hours he became almost totally blind in the left eye. A roentgenogram was then made of the teeth, which showed evi-

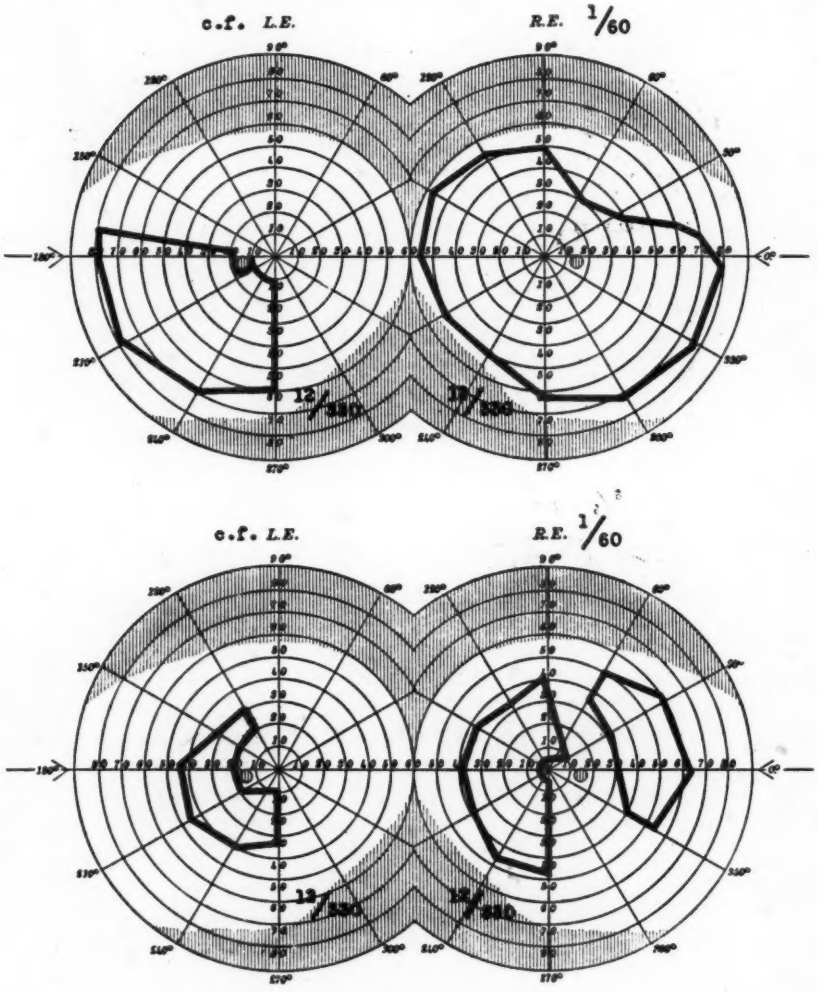

Fig. 3 (case 3).—Perimetric fields showing asymmetric right homonymous hemianopia with loss of central fixation in the left eye and pallor of both disks without loss of substance. The right field of vision (shown in the lower figure) progressed before operation to definite temporal hemianopia with a small island of vision temporarily, resulting from the breaking through in the cecal area which is typical of a chiasmal lesion. There was still pallor of both disks without loss of substance.

dence of periapical infection, and eight teeth were subsequently extracted. The tonsils were found to be infected and were removed also, following which there was a slight generalized reaction with elevation of temperature. Potassium iodide and cod liver oil were administered, and pilocarpine sweats were given once a week, for a few months, and improvement in vision resulted. However, during the three months just previous to registration, the vision remained stationary.

The systolic blood pressure was 138, the diastolic 100; the pulse rate was 88, and the temperature was normal. The specific gravity of the urine was 1.012; it was acid in reaction, and did not contain sugar. The hemoglobin was 79 per cent; the erythrocytes numbered 4,900,000, and the leukocytes 7,000. The Wassermann reaction of the blood was negative. A roentgenogram of the head was negative. The basal metabolic rate was —9 per cent. Ophthalmologic examination revealed a vision of 1/60 in the right eye, and ability to count fingers in the left eye, right homonymous hemianopia, and pallor of the disks without loss of substance (fig. 3). Although the results of the neurologic examination were essentially negative, there was exaggeration of the biceps, triceps, supinators, patellar and achilles reflexes on the left side; the patient was rather dull mentally and did not cooperate well. Some general sepsis was still present, as evidenced by prostatitis, vesiculitis and large submaxillary lymph nodes.

In view of the clinical history and the condition of the eyes, a diagnosis of chiasmal lesion was made. Because of the patient's good health, he was allowed to go home on the assumption that he would come back for observation, and possibly for operation, within a few months. He returned to the clinic five months later and reported progressive failure of vision and decline in health. Examination revealed a definite increase in signs and symptoms, and the perimetric field disclosed specific progression of symptoms.

Because of the infected teeth, headaches, nausea, dimness of vision and the progressive right homonymous hemianopia, a diagnosis was made of chiasmal lesion, probably inflammatory. In view of the marked progress of symptoms since the first examination, the chiasm was explored through a right transfrontal incision. The dura was found to be under the usual tension, and the convolutions were normal in size and appearance. The only abnormal condition was the extreme thickness of the skull over the frontal area where the dura was adherent and slightly thickened. The right frontal lobe was elevated, and dense adhesions were found surrounding the chiasm and optic nerve. Evidence of tumor could not be found, and a diagnosis was made of inflammatory lesion of the chiasm.

Since the patient complained of severe paroxysmal attacks of asthma, oil-ether colonic anesthesia was used at the operation. The patient's condition was good until the third day after operation, when evidence of bronchopneumonia developed, and he died on the fifth day.

At necropsy, the only lesion found was that of chronic basilar arachnoiditis and chronic local arachnoiditis, with marked adhesions around the optic chiasm, thus confirming the observations at operation.

Case 4.—A woman, aged 28, was referred to the clinic because of failure of vision. She first began to experience difficulty with vision thirteen years previously, at which time a refraction had been made, and subsequently she wore glasses. Six weeks before registration, she had considerable vertigo and dizziness, and almost constant pain in the eyes. For one month prior to admission, she had suffered with severe occipital headaches associated with nausea, but no vomiting. She gained 60 pounds (27.2 Kg.) in weight during six months, which might be attributed to the fact that oophorectomy had been performed in 1926. She weighed 220 pounds (99.7 Kg.), and her height was 5 feet, 3 inches (160 cm.); the obesity was mostly above the hips.

The systolic blood pressure was 118, the diastolic 66; the pulse rate was 80, and the temperature was normal. The specific gravity of the urine was 1.038; it was acid in reaction, and did not contain albumin or sugar; microscopic examination gave negative results. The hemoglobin was 78 per cent; the erythrocytes numbered 4,930,000, and the leukocytes 8,100. The Wassermann reaction of the blood was negative. A roentgenogram of the head was negative. The basal metabolic rate was —7 per cent. Ophthalmologic examination showed the vision to be 6/15

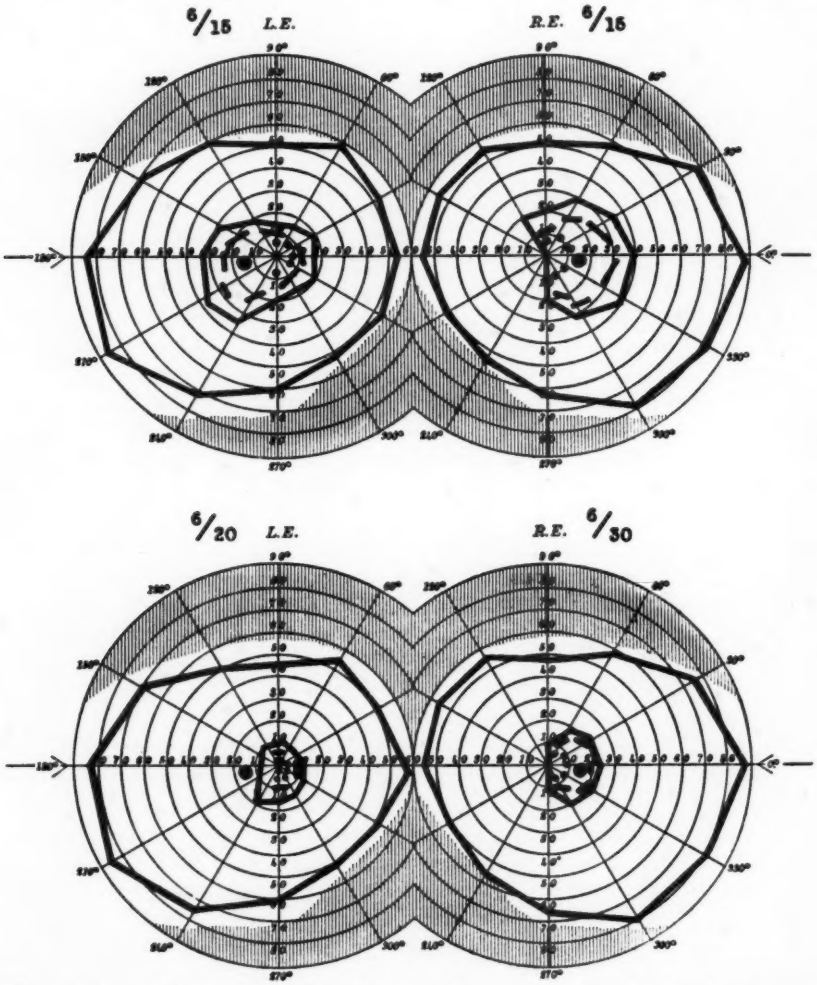

Fig. 4 (case 4).—Perimetric fields showing early visual deterioration with temporal hemianopia from green in the left eye and nasal hemianopia for all colors in the right eye. The color defect progressed in the left eye to definite temporal hemianopia for all colors (shown in lower figure), resulting in definite left homonymous hemianopia for colors. The fundi were normal.

in each eye, and the fundi to be normal, but the perimetric fields revealed left homonymous hemianopia for green (fig. 4). The results of the neurologic examination were objectively negative. At this examination, a chiasmal lesion was suspected, but there was not sufficient evidence to warrant operation.

The patient went home under observation and returned to the clinic six months later, at which time she complained of further failure of vision, bilateral tinnitus and increased severity of headaches. About a month prior to this registration, she had had a headache which lasted for four days, and following this she began to have double vision on looking at distant objects. It was found that vision had diminished from 6/15 to 6/30 with a progression of the color defect. Neurologic examination gave negative results. In view of the progression of symptoms and general decline of her health, surgical procedures were advised.

At operation, the frontal lobe was elevated and both optic nerves were clearly visualized. Adhesions around the midportion of the chiasm were freed by blunt dissection, but other lesions could not be found. A diagnosis was made of inflammatory lesion of the chiasm. The temperature and pulse rate became markedly elevated. The patient became irrational, and in spite of supportive measures, she died two days after the operation. The results of necropsy were negative, except for evidence of marked basomeningitis with encephalitis.

CASE 5.—A boy, aged 8 years, was brought to the clinic because of loss of vision and increasing awkwardness, which had begun about a year previously. Fifteen months before, he had had a severe attack of whooping cough, followed by encephalitis, during which time he slept for almost a week. Following this, he began to complain of headache and blurred vision; he vomited and walked with a marked ataxic gait. His complaints increased in severity, and he became decidedly awkward; he was unable to see, and began to gain in weight. In spite of the symptoms, he continued to attend school, and his grades averaged 90.

The systolic blood pressure was 78, the diastolic 48; the pulse rate was 68, and the temperature was normal. The specific gravity of the urine was 1.020; it was acid in reaction, and contained albumin and pus graded 1, and an occasional erythrocyte; it did not contain sugar. The hemoglobin was 80 per cent; the erythrocytes numbered 9,270,000, and the leukocytes 6,900. The Wassermann reaction of the blood was negative. A roentgenogram of the head revealed a normal sella turcica, with enlarged head and evidence of increased intracranial pressure. The basal metabolic rate on two examinations was —18 and —25 per cent. Ophthalmologic examination revealed satisfactory ocular movements, except for convergence; examination of the perimetric fields disclosed bitemporal hemianopia; there was a vision of 6/20 in the left eye and ability to perceive moving objects in the right eye, and examination of the fundi disclosed full pale disks with normal arteries and veins (fig. 5). There were divergence of the right eye, mild incoordination and mild ataxia. A marked "cracked-pot" sound was noted, and the greatest cranial circumference, the occipital bregmatic, was 57 cm. Because of the bitemporal hemianopia, increase in weight and evidence of increased intracranial pressure, a diagnosis was made of chiasmal lesion.

The chiasm was explored through the usual right transfrontal approach. The right lateral ventricle was tapped through the posterior horn and cerebrospinal fluid escaped under extreme pressure; this allowed the right hemisphere to collapse, and a good view of the chiasm was obtained by elevating the right frontal lobe. The chiasm was found to be free anteriorly and laterally, but there was a bluish discoloration, which resembled a cyst, about the middle of the chiasm. A spinal puncture needle was inserted, and clear cerebrospinal fluid was aspirated. The opening was enlarged and about 40 cc. of clear fluid was obtained, allowing the covering of the chiasm to collapse and relieving the pressure. The lesion appeared to be inflammatory, and the cyst formation was probably part of basal meningitis associated with encephalitis.

In spite of repeated aspirations of the ventricle and other supportive measures, death occurred on the third day after operation.

Necropsy confirmed the observations of basal meningitis with encephalitis found at operation, and revealed gliosis around the aqueduct. This case represents a postencephalitic type of lesion which could not be diagnosed definitely previous to operation.

The foregoing case is included in the group because of the necropsy data and in spite of finding gliosis of the aqueduct. Possibly the associated internal hydrocephalus would eliminate it from the series, but the demonstrable pathologic lesion, both at operation and at necropsy, makes it extremely interesting from the standpoint of chronic local arachnoiditis.

CASE 6.—A man, aged 32, presented himself at the clinic complaining of loss of vision. Ten months previous to registration, he had first noticed that vision in the

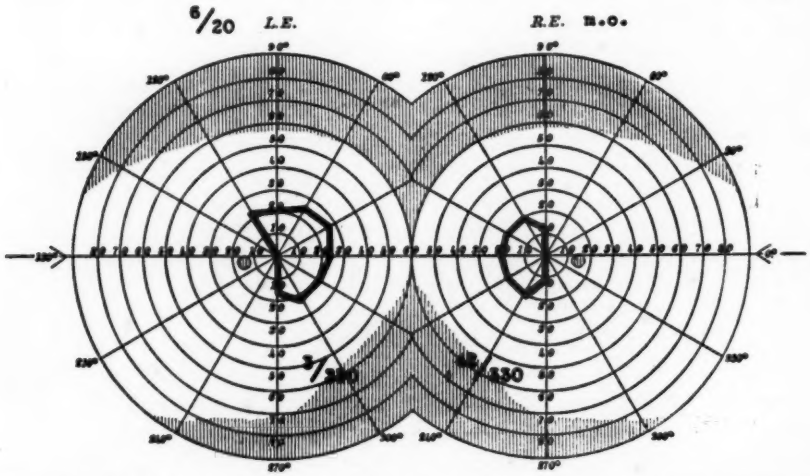

Fig. 5 (case 5).—Perimetric fields showing late bitemporal hemianopia with faulty central fixation in each eye. There was pallor of both disks without loss of substance.

right eye was failing; this began without any pain or redness, and manifested itself as blurring over the eye; the left eye became similarly affected. An operation on the sinus had been performed three months after the onset of the difficulty, and the decreased vision remained stationary. The patient had not had headache and had not lost weight.

The systolic blood pressure was 128, the diastolic 88; the pulse rate 84, and the temperature normal. The specific gravity of the urine was 1.030; it was acid in reaction and contained albumin, graded 1. The results of the microscopic examination were negative. The hemoglobin was 78 per cent; the erythrocytes numbered 4,620,000, and the leukocytes 4,800. The Wassermann reaction of the blood was negative. A roentgenogram of the skull was negative. The basal metabolic rate was —8 per cent. The vision in both eyes was 1/60. Examination of the perimetric fields showed a partial right homonymous hemianopia, with bilateral cecocentral scotomas. Examination of the fundi revealed bilateral simple optic

atrophy with contraction of the arteries (fig. 6). Neurologic examination gave essentially negative results. The tonsils had been cleanly removed; the nose and pharynx were normal.

In view of the failing vision and the defect in the perimetric fields, a diagnosis of chiasmal lesion was made; operation was advised, although a tumor was not predicated. Through a right transfrontal approach, the frontal lobe was elevated,

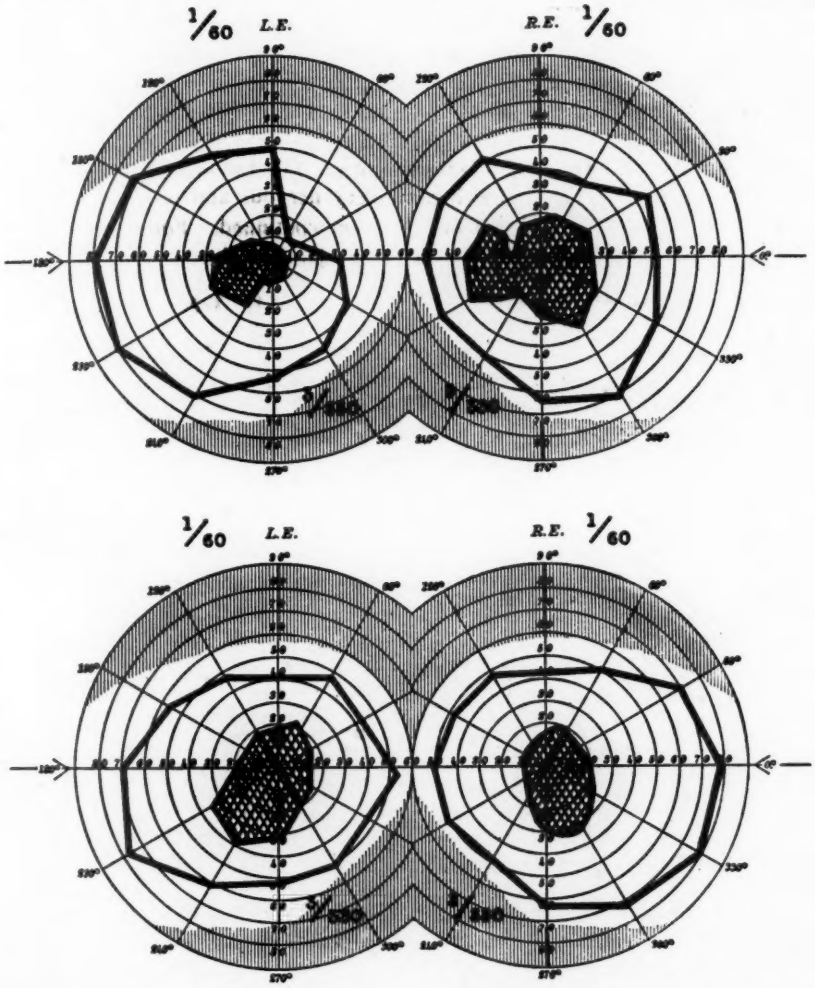

Fig. 6 (case 6).—Perimetric fields showing partial right homonymous hemianopia and bilateral cecocentral scotomas. Examination of the fundi showed simple optic atrophy in each eye. After operation (shown in lower figure) there was improvement to slight concentric contraction for form, although the cecocentral scotomas remained. This type of field is usually produced by a prechiasmal or a basal lesion of the frontal lobe.

and the optic chiasm was fully exposed. There were filmy, fibrous, grayish adhesions about the chiasm and extending down the optic nerves. The chiasm appeared fairly normal aside from this inflammatory reaction. The adhesions were freed with a blunt hook.

Convalescence was uneventful, and one month after operation the perimetric fields were found to be essentially the same as they had been before operation. The patient returned home and remained in a satisfactory physical condition, but vision did not improve.

CASE 7.—A girl, aged 8 years, was brought to the clinic because of failing vision. She had been a normal baby, had walked at the age of 18 months, was rather slow in learning to talk, and lisped. She had had influenza at the age of 2 years and whooping cough at the age of 5. She entered public school when she was 6 and did exceptionally well in her school work, but complained frequently of headache. Seventeen months before registration, she came home from school one day complaining of headache with severe pain on the top of her head; this continued every day for two weeks, and during this time she had photophobia, although she did not have diminution of vision. The headaches disappeared suddenly after two weeks. The child became very nervous and was easily fatigued; however, the photophobia and failure of vision continued. Following the disappearance of the headache, the patient began to gain weight.

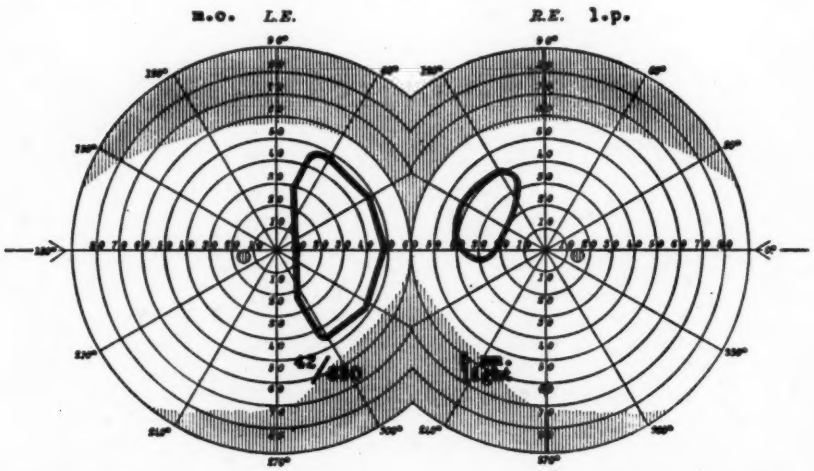

Fig. 7 (case 7).—Perimetric fields showing late phase of bitemporal hemianopia with loss of central fixation in each eye and asymmetry in the remaining fields of vision.

The systolic blood pressure was 82, the diastolic 40; the pulse rate was 88, and the temperature was normal. The specific gravity of the urine was 1.012; it was acid in reaction, did not contain albumin or sugar, and was microscopically negative. The hemoglobin was 80 per cent; the erythrocytes numbered 4,940,000, and the leukocytes 6,300. The Wassermann reaction of the blood was negative. A roentgenogram of the skull and one of the thorax were negative. The right eye was able to perceive light and the left eye, moving objects. The pupils were equal and reacted slowly to light. Examination of the fields revealed bitemporal hemianopia with loss of fixation in each eye (fig. 7). Neurologic examination showed rotary and vertical nystagmus with bilateral diminution of the patellar, achilles, internal and external hamstring reflexes. The patient weighed 57 pounds (25.9 Kg.). A diagnosis was made of chiasmal lesion, probably inflammatory, and operation was advised.

Through a right transfrontal incision, the chiasm was explored. The optic nerves were covered with a grayish exudate, and occupying the sellar region was a cystic area which could not be distinguished from the posterior part of the optic nerve or the chiasm. This was opened and tissue was removed, which proved, on microscopic examination, to be inflammatory. The adhesions about the optic chiasm were freed with a blunt hook, and the wound was closed. Following an uneventful convalescence, the patient was dismissed from our care with slight improvement in vision and reflexes.

This girl was the youngest patient in the series in whose case there were no known etiologic factors. The appearance of the optic chiasm at operation was similar to the chiasm in the preceding cases, and microscopic examination of the tissue removed showed it to be definitely inflammatory.

BASOFRONTAL GROUP

Lesions involving the basal portion of the frontal lobe, or arising in the olfactory groove, produce a definite ophthalmologic syndrome. The syndrome of Gowers-Paton-Kennedy was optic atrophy and scotoma on the side of the lesion and choked disk in the other eye. Further experience indicates that several combinations of signs may occur: (1) unilateral central scotoma with normal fundi; (2) unilateral central scotoma and pallor of the disk, but normal conditions in the other eye; (3) bilateral central scotoma with pallor of both disks; (4) bilateral central scotoma with choked disks in both eyes; (5) unilateral amaurosis with simple optic atrophy, and choked disk in the opposite eye; (6) unilateral amaurosis with simple optic atrophy and choked disk and central scotoma in the opposite eye; (7) central scotoma and various alterations of the peripheral fields due to secondary contraction resulting from choked disks, and (8) bilateral amaurosis with any of the foregoing changes in the fundus.

Such variations in the ocular signs are indicative of the various influences to which the optic nerves are subjected and also of the associated influence of the choked disks. In certain cases the situation of the tumor may be such as to affect the chiasm by extension, thus adding further changes in the field. If the evolution of the ocular changes can be studied repeatedly, the data furnished should permit an accurate estimation of the site, rate and mode of extension of the lesion. The steadily progressive evolution of these signs is the main support of the diagnosis of tumor as distinguished from other conditions which produce some of the foregoing signs, especially scotoma and simple optic atrophy such as are seen in multiple sclerosis, basal gummatous meningitis and other inflammatory lesions. Usually inflammatory conditions have a rapid onset, are progressive for a short

time, and then regress noticeably, regardless of the type of treatment employed; thus they are distinguished from the slowly progressive syndrome generally produced by tumor.

Basal gummatous meningitis and chronic local arachnoiditis are two types of inflammation which clinically usually produce a slowly progressive syndrome affecting the prechiasmal and chiasmal region. The former can be diagnosed readily by the serologic changes and cytologic changes in the cerebrospinal fluid and needs no further consideration here.

CASE 8.—A woman, aged 37, came to the clinic complaining of failing vision. One year previously, she began to have frequent attacks of vertigo and noticed impairment of vision in the right eye, when she experienced a sensation as if a black curtain were drawn over the eye for a few minutes at regular intervals; these attacks of temporary blindness gradually increased in frequency and in length. Six months before examination, she first had numbness and tingling in the fingers of both hands, which disappeared after about five minutes but recurred regularly three or four times a week; three months later, she suffered a generalized convulsion which lasted only a few moments, and which was the only attack she ever had. Two weeks before registration, vision decreased rapidly, especially in the margin of the fields. The patient also stated that she suffered from mild headaches at menstrual periods, and that her menses were becoming irregular; she had menstruated only twice in the previous year. She had not gained weight.

The systolic blood pressure was 146, the diastolic 80; the pulse rate was 84, and the temperature was normal. The specific gravity of the urine was 1.023; it was acid in reaction and contained albumin and pus graded 1, but no sugar. The hemoglobin was 76 per cent; the erythrocytes numbered 4,440,000, and the leukocytes 7,600. The Wassermann reaction of the blood was negative. A roentgenogram of the head and one of the thorax were negative. Later roentgenograms of the sella turcica were also negative. The basal metabolic rate on two examinations was +11 and +9 per cent. The vision in the right eye was 6/7 and in the left eye 6/5. Movements of the eyes were normal. A choked disk of 2 diopters in the right eye and of 1 diopter in the left eye were noted; examination of the perimetric fields showed a right nasal hemianopia (fig. 8).

Because of headaches, irregular menstruation and right nasal hemianopia, a diagnosis of chiasmal lesion was made, and operation was advised. Through a transfrontal approach, the right frontal lobe was elevated, and the chiasm was found to be covered with an exudate and bound down with adhesions. On incision of the dura, it was noticed that there was a definite exudate on the arachnoid over the right hemisphere; the adhesions about the chiasm were freed with a blunt hook. The space between the convolutions was filled with fluid which contained flocculent material, signifying that the entire right frontoparietal lobe was the seat of an inflammatory process; evidently, the same process which bound down the chiasm with adhesions involved the base.

The postoperative course was uneventful, and the wound healed by primary intention. When the perimetric fields were examined twelve days after operation, there was marked improvement in the right nasal hemianopia, and the choked disk in the left eye had receded. The patient was permitted to return home, and three months after the operation, a letter was received from her local physician,

stating that she had improved greatly since her return home, and that there was almost complete return of the right nasal field of vision.

This case represents meningo-encephalitis, in which the chiasm had been involved in adhesions which were freed at operation, thus producing definite improvement.

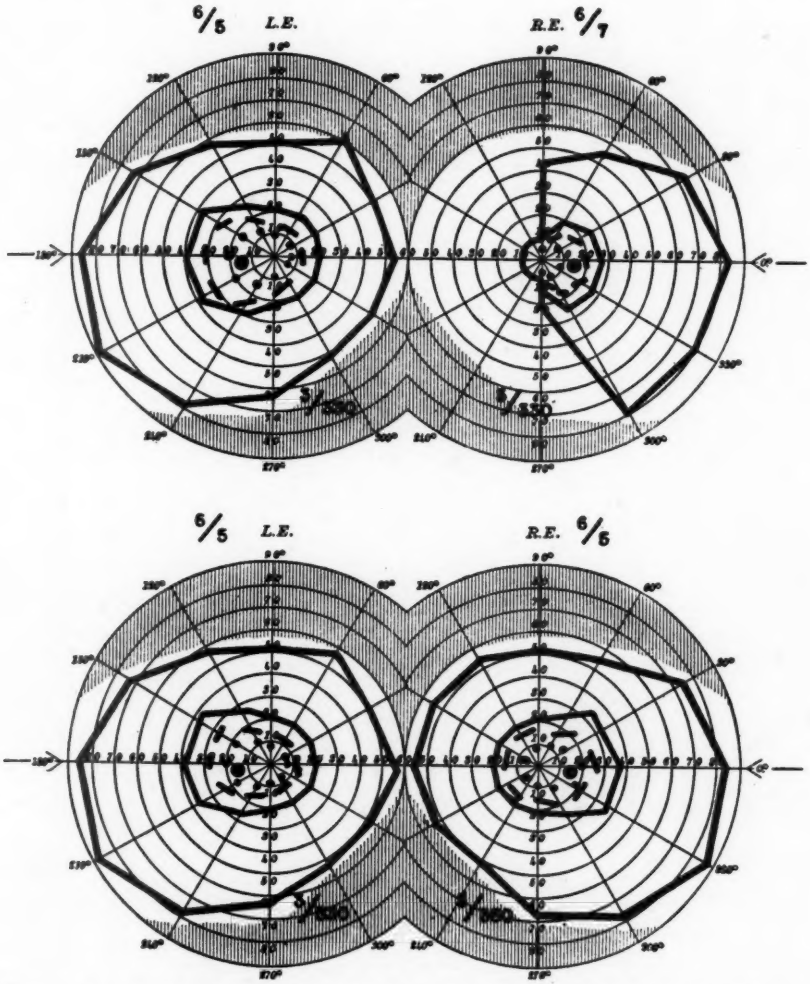

Fig. 8 (case 8).—Perimetric fields showing definite nasal hemianopia in the right eye with normal field of vision in the left which, associated with bilateral choked disks of 2 diopters in the right eye and 1 diopter in the left eye, is a definite right basal frontal syndrome from the ophthalmologic standpoint. The return of vision and fields to normal justifies a surgical procedure in this type of case. The lower figure was made three months after operation. The fundi were then normal.

In contrast to the foregoing cases, in case 8 a definite right baso-frontal syndrome was manifested. The inflammatory condition of the optic chiasm found at operation appeared to be only a part of a general

meningeal low grade infection. The clinical picture was rather confusing as the patient had experienced irregular menses, headache, vertigo and one brief generalized convulsion; further symptoms complicating the preoperative diagnosis were the papilledema in the left eye and right nasal hemianopia, which signify a prechiasmal or right basofrontal lesion. The appearance of the meninges at operation gave the first intimation that an inflammatory lesion was the underlying pathologic change. The surgical removal of adhesions, with the denuding of the nerves which were covered by exudation, was justified by the postoperative improvement in vision.

SURGICAL PROCEDURE

The surgical procedure employed in the cases in which the optic chiasm was explored was that described by Heuer and Adson.[5] The exploration is always carried out on the right side, unless there are definite indications for a left-sided approach, such as marked involvement of the left side of the chiasm, or the left optic nerve. The incision of the scalp is similar to that for a large frontotemporoparietal osteoplastic flap, the anterior limb of which is just within the hairline, and in addition, a curved incision is made at right angles with the juncture of the anterior and longitudinal edges of the flap, extending over the forehead to the median line, almost to the level of the glabella (fig. 9). After the frontal skin flap has been reflected, five trephine openings are placed in the usual manner, with the exception of the most anterior one which is placed about 3 cm. from the median line and just above the edge of the frontal sinus. The osteoplastic flap is then reflected after the five trephine openings are connected by means of the Gigli saw and the base of the bone flap narrowed by means of DeVilbiss rongeur forceps. After the middle meningeal artery has been ligated, a curved incision is made in the dura extending over the frontal and temporal regions in such a manner as to be reflected in the opposite direction from the osteoplastic flap. The dura along the anterior margin is retracted by means of small silk sutures which are attached to the towels along the margin of the wound. The frontal lobe is elevated after protecting the cortex with small flat cotton strips, and the optic chiasm is exposed, allowing exploration with a lighted retracter (fig. 10). In this manner, the entire optic chiasm can be explored and any associated lesion can be treated as deemed expedient at operation.

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5. Adson, A. W.: Hypophyseal Tumors; Removal Through the Intradural Approach, J. A. M. A. **71**:721 (Aug. 31) 1918.

Fig. 9.—Outline of skin incision and osteoplastic flap for the transfrontal intradural operation.

Fig. 10.—Exposure of optic chiasm by means of transfrontal intradural procedure revealing chronic local arachnoiditis.

SUMMARY

When pituitary tumor is suspected and roentgenograms show enlargement of the sella turcica, associated with signs of hypophyseal dysfunction, it is nearly always possible to make a preoperative diagnosis. In one case in our series, however, there was definite evidence of hypophyseal dysfunction, and at operation an inflammatory lesion was encountered. Craniopharyngeal pouch cysts usually manifest themselves relatively early in life, and roentgenograms reveal shadows cast by calcium deposits in the wall of the cyst. Gliomas of the optic chiasm have been found to occur with relative rarity and often have an associated anterior pouching of the sella turcica, as revealed by the roentgenograms. Aneurysms around the optic chiasm seldom have an audible bruit and sometimes present difficulties in making a differential diagnosis, although the roentgenogram is often pathognomonic. Suprasellar meningiomas generally occur in persons who complain only of impairment of vision; the fields become bitemporally constricted, although as a rule the process does not advance with equal steps in both eyes, and a roentgenogram of the sella turcica is negative. As a rule, there is little or no hypophyseal dysfunction associated with this group.

From observation, it is apparent that there is a certain percentage of cases in which symptoms of chiasmal lesion are present, and in which it is impossible to predicate the underlying lesion. Further, it is evident that patients who fail to respond to conservative methods of treatment for this condition are faced with a grave prognosis, unless radical measures are adopted. Certain cases of chiasmal lesions which simulate pituitary disorders do not reveal evidence of neoplasm at operation, and often a definite inflammatory condition involving the region of the optic chiasm is disclosed; the optic nerves may be found to be covered with an inflammatory exudate and bound down in a mass of adhesions. Tumefaction of the inflammatory exudate, which consists of encysted fluid, may also be present; by freeing the adhesions with a blunt hook, and allowing the escape of the encysted fluid, it is possible to check the progress of the condition or to alleviate the symptoms.

CONCLUSIONS

Chronic local arachnoiditis affecting the optic chiasm is a definite clinical entity.

The chiasmal syndrome is similar to that produced by tumor in this region.

A definite preoperative diagnosis of the underyling lesion cannot always be predicated.

Operative results in this group justify surgical exploration.

EXTRACTION OF CATARACT

REPORT OF A THIRD HUNDRED SUCCESSIVE EXTRACTIONS IN THE CAPSULE AFTER PRELIMINARY SUBLUXATION WITH THE CAPSULE FORCEPS *

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The type of senile cataract suited for this method of intracapsular extraction after subluxation is that in which the capsule is dense enough to hold the grasp of the forceps; hence, cataracts in patients under 50 years of age are usually excluded. The capsule in the case of a glistening cortex (mother of pearl) ruptures; the sclerosed lens, with posterior cortical opacity, dislocates readily, as do those with a thickened capsule; the morgagnian cataract is difficult to grasp, as the capsule is elusive, and when finally grasped, it ruptures easily. The section must be large enough, especially in undersized eyes, in which the incision should be scleral throughout.

The operation is contraindicated when the eyes are prominent, when there is a complication due to vitreous disturbance (myopic eyes, soft eyes, cyclitic eyes) and when the patient shows nervousness or restlessness. In any of these cases, the toothed forceps or cystotome should be used.

TECHNIC

The most important step in the technic is the use of the capsule forceps. In all intracapsular methods the first and essential step is the subluxation of the cataract. To accomplish this, I use the Kalt capsule forceps, the tips of which are blunt and like a bisected cup. The forceps take hold of the capsule sufficiently firmly to grasp it without cutting it at the point of application. It is important that the capsule be grasped in the lower third of the anterior part, because the subluxation thus follows in the lower periphery, and if the capsule should tear, the opening will be in the center of the pupil. After grasping the capsule in this region, the point of the Smith hook makes counterpressure at the lower limbus backward and downward, and the capsule forceps is carefully manipulated from side to side, forward or upward, and subluxation below usually takes place promptly. It is recognized by the lower margin of the lens appearing within the pupil and remaining there if subluxation has occurred. The capsule forceps is then promptly released. Due care is taken that the section is large enough, and the retractors replace the speculum if any complication is feared. Then with the tip of the Smith lid hook pressing straight back at the lower limbus with counterpressure above against the scleral lip of the incision, the cataract revolves forward; in other words, it tumbles until the diameter has passed through the incision. The

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extraction is completed by sweeping the cataract upward, thus separating its final upper attachment. The operation is then completed in the usual manner.

If subluxation does not readily occur, though the grip is firm, the procedure is desisted from, as the suspensory attachment is too strong and undue traction on the ciliary fibers is not advisable. Toothed forceps are then applied. If the lens is subluxated but does not promptly tumble, the capsule is again grasped, and the subluxation is enlarged; the lens will then promptly tumble and appear in the section. Sometimes unexpectedly, often by an upward movement of the patient's eye, the subluxation takes place laterally or above. The completion of the subluxation is then more difficult, and precautions (retractors) are necessary to avoid prolapse of the vitreous. The head-on delivery is not favored because the suspensory is torn in the upper field just in the region of the section, and the tendency to prolapse of the vitreous is magnified. Persistent traction and pulling the cataract out with the capsule forceps (Stanculeanu-Török) are objectionable because of greater traumatism, greater danger of prolapse of the vitreous and more likelihood of rupture of the capsule during the process of delivery.[1]

ANALYSES OF CASES

Beginning from where my last report ended,[2] I have collected the next successive 100 cases of intracapsular extraction for analysis. These cases, with the exception of the 2 in which the patients died in the hospital, are tabulated as follows:

The cataracts can be grouped thus: mature, forty; nuclear and posterior cortical, twenty-seven; complicated, fifteen; hypermature, fifteen, and morgagnian, three.

The cataracts were delivered in the following manner: ninety-three tumbled, in five of which the capsules ruptured and were secondarily extracted and in one, the capsule ruptured and remained in the upper pupil; there was head presentation in three cases, and four cataracts were grasped a second time and pulled out, one capsule rupturing.

The period of hospitalization is generally between fourteen to twenty-one days; in this type of operation it is well to be more careful than usual, and to wait for the firm closure of the wound.

As these patients were operated on between 1921 and 1925, the cases could be followed, and the visual results given are those found at the last examination. In some, the good early vision was lost through a return of the iridocyclitis or the development of a detachment in two.

The visual results were: fifty-six cases, 20/20; eighteen, 20/30; five, 20/40; one, 20/50; six, 20/70; two, 20/100; two, 20/200; four, fingers; three, hand movement; two, light perception; one, failure. In brief, vision in seventy-four was 20/30 or better.

1. Knapp, A.: On Methods of Dealing with Capsule in Cataract Extraction, Arch. Ophth. **50**:115, (March) 1921.

2. Knapp, A.: Report of a Second Hundred Successive Extractions of Cataract in the Capsule After Preliminary Subluxation with Capsule Forceps, Arch. Ophth. **50**:426 (Sept.) 1921.

Of these cases, the following complications occurred in seventeen: maculae corneae, two; vitreous opacities, three; choroidal changes in the fundus, six; old detachment, one; optic atrophy, four; amblyopic eye, one.

The vitreous was lost in seven cases. It was very small in amount and usually occurred at the end of the operation after the cataract had been extracted. Healing was prompt, and resulting vision was satisfactory. No great damage was done to the vitreous (opacities), as no instrument was introduced into the eye. The detailed report of these seven cases is as follows: In case 2 in this series, a bead of vitreous followed extraction of the cataract. Vision was 20/30. In case 5, there was congenital irideremia. Lateral dislocation was done, with immediate vitreous oozing, and the cataract was extracted without further loss. Choroidal hemorrhage occurred. Vision was 5/200. This will be discussed later. In case 22, dislocation took place temporally, which is always serious. The cataract was again seized and pulled out with some vitreous following. Vision was 20/20. In case 28, a bead of vitreous followed the lens. Two weeks later, iritis occurred. There was opacity of the hyaloid membrane with updrawn pupil, requiring iridotomy. Vision was 20/40. In case 41, there was slight prolapse of the vitreous on straightening out the conjunctival flap. Vision was sufficient to see movements of the hands (optic atrophy). In case 80, the vitreous followed the extraction of a morgagnian cataract. Vision was 20/20. In case 91, in which a morgagnian cataract was present, the capsule ruptured, there was a fluid cortex, and the vitreous followed extraction of the nucleus. Vision was 20/70.

Iridocyclitis was observed in eight cases. In case 28, that of a patient, aged 72, the second week following extraction of a hypermature cataract, iritis developed, ending in opacity of the hyaloid membrane and updrawn pupil. After iridotomy, vision was 20/40. In case 34, that of a patient, aged 60, iritis developed in the second week following extraction of a mature diabetic cataract. On discharge from the hospital, vision was 20/30. One month later, iritis with glaucoma recurred, necessitating iridectomy. There was vitreous hemorrhage. Vision was 15/200. The patient disappeared from observation. In case 38, that of a patient, aged 79, with mature cataract, iritis resulted in a hazy hyaloid membrane; retinal hemorrhage occurred. Vision was 20/70. The patient disappeared from observation. In case 42, that of a patient, aged 70, with mature cataract, iritis developed. Vision was 20/30. In case 43, that of a patient, aged 58, with complicated cataract, extraction was followed by iritis. There was opacity of the hyaloid membrane. Vision was 10/200. Then deep opacity appeared in the cornea. The tension was increased. Vision was sufficient for light perception. The

patient disappeared from observation. In case 72 that of a patient, aged 76, with nuclear cataract, iritis developed. Vision was 20/50. Opacity of the cornea, updrawn pupil and glaucoma developed. Vision was 2/200. In case 86, that of a patient, aged 54, with mature cataract, iritis developed. Vision was 20/20. In case 94, that of a patient, aged 74, with complicated cataract, nystagmus, iritis and old choroiditis, vision was sufficient for perception of light.

Reopening of the wound with hyphema, "Wundsprengung," occurred in ten cases. This unpleasant complication is, of course, not peculiar to the intracapsular cases. It usually does not affect the ultimate vision, but lengthens the period of hospitalization. It generally occurs soon after operation, during the night, on first awakening, when the patient squeezes his eye in a semiconscious state, or during the first dressing, a time when the greatest care has to be exercised. In two cases there was blood in the vitreous and the vision was reduced, in case 8, to 20/40, and in case 65, to 20/50. In one case, a red blood clot remained on the hyaloid membrane for three months. Vision was 20/30.

Expulsive hemorrhage or retrochoroid hemorrhage in its usual severity occurred in one case in which enucleation was then done; in one case the hemorrhage was partial, and the eye was saved. The first case (case 88) occurred in a woman, aged 80, with a mature cataract. Two hours after operation, there was expulsive hemorrhage with the usual symptoms. Enucleation was done. In the second case (case 5), that of a patient 33 years old with congenital irideremia, when the capsule was grasped, dislocation was immediate, with prolapse of the vitreous on the temporal side. The cataract was extracted without further loss. There was some vomiting during the first night. On the second day, on dressing, the wound was found open, with blood-stained vitreous, uveal tissue and reflected flap; oozing continued for some days. Then the wound slowly closed, the anterior chamber cleared, and after six weeks a choroidal detachment was visible above. Vision with + 12 sphere was 5/200. The patient then returned to her home at some distance from New York and was lost from observation. Detachment of the choroid was present in one case; this promptly subsided, and vision of 20/20 was obtained.

Detachment of the retina is a complication for which I have been particularly on the lookout; it occurred in the two following cases: In case 44, that of a patient, aged 63, with mature cataract, the period of hospitalization was seventeen days; a good result was obtained, though there were some opacities of the vitreous. One year later, detachment of the retina with a tear in the retina developed. Vision was sufficient for seeing hand movements. In case 78, that of a patient, aged 62, with

Extractions of Cataract in the Capsule

No.	Age	Cataract	Vitreous	Healing	Final Result	
1	61	Mature	.....	.....	20/ 20	
2	62	Complicated	Positive	.....	20/ 30	
3	59	Nuclear	.....	.....	20/ 20	
4	70	Complicated	.....	.....	20/ 40	Maculae corneae
5	33	Complicated	Positive	.....	5/200	Partial subchoroidal hemorrhage
6	58	Nuclear	.....	.....	20/ 30	
7	56	Nuclear	.....	.....	20/ 20	
8	80	Mature	.....	.....	20/ 40	Vitreous opacities
9	54	Nuclear	.....	.....	20/ 20	
10	60	Nuclear	.....	.....	20/ 30	
11	62	Mature	.....	.....	20/ 30	
12	55	Nuclear	.....	.....	20/ 20	
13	72	Mature	.....	.....	20/ 40	Choroiditis
14	69	Nuclear	.....	.....	20/ 20	
15	65	Nuclear	.....	Hyphema	20/ 20	
16	62	Mature	.....	.....	20/ 30	
17	70	Hypermature	.....	.....	20/100	Choroiditis
18	77	Hypermature	.....	.....	20/ 30	
19	60	Mature	.....	.....	20/ 30	
20	65	Mature	.....	.....	20/ 30	
21	58	Nuclear	.....	.....	20/ 20	
22	58	Nuclear	Positive	.....	20/ 20	
23	80	Mature	.....	.....	20/ 20	
24	71	Nuclear	.....	Hyphema	20/ 20	
25	62	Mature	.....	.....	20/ 20	
26	70	Complicated	.....	.....	20/ 70	Maculae corneae
27	73	Mature	.....	.....	20/ 20	
28	72	Hypermature	Positive	Iritis	20/ 40	Iridotomy
29	73	Mature	.....	.....	20/ 70	Choroiditis
30	63	Complicated	.....	.....	20/ 70	Choroiditis
31	60	Mature	.....	Hyphema	20/ 30	Blood clot on hyaloid 3 months
32	60	Nuclear	.....	.....	20/ 20	
33	51	Mature	.....	.....	20/200	Amblyopic eye
34	60	Mature	.....	Cyclitis with glaucoma	15/200	Disappeared
35	65	Complicated	.....	.....	20/ 20	
36	56	Mature	.....	.....	20/ 20	
37	63	Complicated	.....	Hyphema	20/ 70	Choroiditis
38	79	Mature	.....	Iritis	20/ 70	Vitreous opacities, retinal hemorrhage
39	69	Mature	.....	.....	20/ 20	
40	52	Mature	.....	.....	20/ 20	
41	67	Morgagnian	Positive	.....	Hand movements	Optic atrophy
42	70	Mature	.....	Iritis	20/ 30	
43	58	Complicated	.....	Iritis	Light perception	Disappeared
44	63	Mature	.....	.....	Hand movements	Detachment of retina
45	56	Mature	.....	.....	20/ 20	
46	55	Nuclear	.....	.....	20/ 30	
47	62	Nuclear	.....	.....	20/ 20	
48	70	Mature	.....	.....	20/ 20	
49	53	Complicated	.....	.....	20/ 20	
50	68	Hypermature	.....	.....	20/ 20	
51	58	Nuclear	.....	.....	20/ 20	
52	71	Mature	.....	.....	20/ 20	
53	77	Mature	.....	.....	20/ 30	
54	60	Mature	.....	Hyphema	20/ 20	
55	70	Nuclear	.....	.....	20/ 20	
56	75	Mature	.....	.....	20/ 20	
57	58	Nuclear	.....	.....	20/ 30	
58	49	Nuclear	.....	.....	20/ 30	
59	64	Mature	.....	.....	20/ 20	
60	73	Nuclear	.....	.....	20/ 20	
61	68	Nuclear	.....	.....	20/ 20	
62	66	Nuclear	.....	Hyphema	20/ 20	
63	65	Hypermature	.....	.....	20/ 20	
64	69	Mature	.....	.....	20/ 20	
65	78	Mature	.....	Hyphema	20/ 50	Blood in vitreous
66	67	Complicated	.....	.....	20/200	Old detachment of retina
67	63	Nuclear	.....	.....	20/ 20	
68	73	Nuclear	.....	.....	20/ 20	
69	58	Complicated	.....	Hyphema	20/ 20	
70	54	Nuclear	.....	.....	20/ 20	
71	58	Hypermature	.....	.....	20/ 20	
72	76	Nuclear	.....	Iritis	2/200	Iridocyclitis
73	73	Hypermature	.....	.....	20/ 20	

Extractions of Cataract in the Capsule—Continued

No.	Age	Cataract	Vitreous	Healing	Final Result	
74	61	Mature	.....	.....	20/ 20	
75	68	Hypermature	.....	.....	20/ 20	
76	79	Complicated	.....	.....	20/ 20	
77	68	Nuclear	.....	.....	20/ 30	
78	62	Hypermature	.....	.....	Hand movements	Detachment
79	68	Complicated	.....	.....	20/100	Choroiditis
80	65	Nuclear	Positive	.....	20/ 20	
81	65	Mature	.....	.....	20/20	
82	55	Nuclear	.....	.....	20/ 20	
83	63	Hypermature	.....	.....	20/ 30	
84	68	Nuclear	.....	Hyphema	20/ 20	
85	66	Nuclear	.....	.....	20/ 20	
86	54	Mature	.....	Iritis	20/ 20	
87	71	Mature	.....	Glaucoma	5/200	Tension, normal; optic atrophy
88	80	Mature	.....	Expulsive hemorrhage, enucleation		
89	54	Hypermature	.....	.....	20/ 20	
90	81	Hypermature	.....	.....	20/ 20	
91	83	Mature	.....	.....	20/ 20	
92	56	Hypermature	.....	.....	20/ 30	
93	80	Mature	.....	.....	20/ 40	Temporal optic atrophy
94	74	Complicated	.....	Iritis	Light perception	Optic atrophy
95	66	Mature	.....	.....	20/ 20	
96	75	Morgagnian	.....	Glaucoma	20/ 20	Tension, normal
97	59	Mature	.....	.....	20/ 20	
98	69	Nuclear	.....	.....	20/ 30	
99	76	Morgagnian	Positive	.....	20/ 70	Disappeared
100	73	Mature	.....	Chorold detachment	20/ 20	

hypermature cataract, dislocation was difficult; the capsule was grasped a second time and was pulled out. There were fine vitreous opacities. Vision was 20/20. Eighteen months later, detachment of the retina occurred.

I have since seen another case, making three cases in my experience with intracapsular extraction. In this case there was some iritis with disturbance of the vitreous; vision at first was 20/20, then two years later there was retinal detachment. There seemed to be no reason to associate the detachment with any manipulation peculiar to this method of extraction.

Prolapse of the iris occurred in one case (case 62), and was excised with the patient under general anesthesia. The resulting vision was 20/20.

Glaucoma was not observed in this series unless as a part of the cyclitis. In the two cases of preceding glaucoma, cases 87 and 96, the glaucoma did not return after the extraction of the cataract in the capsule.

INTRA-OCULAR BLASTOMYCOSIS *

VIRGIL J. SCHWARTZ, M.D.
MINNEAPOLIS

Blastomycosis is a subacute or chronic disease due to a yeast fungus which attacks the skin and various internal organs, producing granulomatous and suppurative lesions and, particularly, small, chronic abscesses.

The first case was reported by Gilchrist [1] in 1894 at a meeting of the American Dermatological Association. He had found an unusual disease of the skin in which peculiar bodies, with the appearance of parasites, were found. They were classified as blastomycetes. Six months later, Busse and Buschke [2] reported a case of pyemia, that is, a systemic disease, caused by a pathogenic yeast of similar appearance. Then followed a considerable number of individual case reports by various writers, including Stokes, Wells, Hessler, Hyde, Hektoen and Bevan,[3] climaxed by the comprehensive article of Ricketts [4] in 1901 in which he reviewed the cases on record and reported twelve new ones. In 1907, Hektoen [5] and in 1908, Montgomery and Ormsby,[6] presented new summaries of case records then available. Of the more recent articles, that of Wade and Bel,[7] and particularly that of Stober,[8] are complete and instructive.

The organism is a spherical or oval body, ordinarily from 7 to 20 microns in diameter, that is, two or three times the size of a polymorphonuclear leukocyte. It is found in the lesions, pus and sputum, and discloses a characteristic double-contoured, hyaline capsule within which is a finely granular protoplasm, but no nucleus. These bodies multiply by budding. Growth takes place on ordinary culture mediums at room temperature, but the most favorable culture medium is Sabou-

* Submitted for publication, April 9, 1930.

* Read before the Section on Ophthalmology at the Eighty-First Annual Session of the American Medical Association, Detroit, June 27, 1930.

1. Gilchrist, T. C.: Johns Hopkins Hosp. Rep. **1**:269, 1896.
2. Busse and Buschke: Centralbl. f. Bakt. **16**:175, 1894.
3. Bevan: Brit. J. Dermat., July, 1889.
4. Ricketts, Howard: J. M. Research **1**: 373, 1901.
5. Hektoen, Ludvig: Systemic Blastomycosis and Coccidioidal Granuloma, J. A. M. A. **49**:1071 (Sept. 28) 1907.
6. Montgomery, F. H., and Ormsby, O. S.: Systemic Blastomycosis, Arch. Int. Med. **2**:1 (Aug.) 1908.
7. Wade, H. W., and Bel, G. S.: A Critical Consideration of Systemic Blastomycosis, Arch. Int. Med. **18**:103 (July) 1916.
8. Stober, A. M.: Systemic Blastomycosis, Arch. Int. Med. **13**:509 (April) 1914.

raud's 4 per cent dextrose agar. Growth also takes place on sterile bread, paper, cardboard, wood and similar articles. In the incubator, a macroscopic growth is produced in from two days to two weeks. Animals can be infected by inoculation.

No definite predisposing causes are known. A preponderance of early case reports from the Chicago district probably only signified better recognition of the disease in that locality. Cases have been reported in various parts of North America and a few in other foreign countries. Men are much more frequently affected than women, possibly because of the greater frequency of outdoor occupation. The age incidence is not definite, but adults in the third and fourth decades of life seem to be affected more frequently than others. Unhygienic surroundings may be a factor. Stober thinks that the growth of fungi on decaying boards, walls, food and other substances may lead to infection by inhalation. Injury to the skin may lead to infection. Wade inoculated a monkey with blastomycetes subcutaneously and found pulmonary infection after the original abscess of the skin had healed. Cases of primary intestinal infection have been reported. The infection spreads by continuity and occasionally by the lymphatics or the blood stream. More than 140 cases of the skin type and 40 cases of the generalized type of blastomycosis have been reported.

Wade and Bel stated that the most frequent locations of the lesions are the lungs and the skin, while the most rare are the tongue, tonsils, trachea, esophagus, diaphragm and eye. A concise, yet adequate, account of blastomycosis in general is given in "Oxford Medicine,"[9] from which some of the following description is quoted: The skin lesions are usually multiple, rather superficial nodules, from 0.5 cm. in diameter upward, which break down and discharge pus so as to form open abscesses, fistulas, crusted or open ulcers and, later, irregular scars. Other characteristic lesions of the skin are raised areas varying in size, having an uneven granular or papillomatous surface and a sharp, sloping, purplish red margin, the whole having an irregular contour. The border of the patch typically shows a large number of miliary abscesses. In the lungs there are usually large numbers of discrete miliary to pea-sized abscesses or confluent areas of softening, in which may be found thick pus or soft, cheesy, necrotic material. The involvement is of bronchopneumonic type. Blastomycetes are always found in these areas. There are also, of course, many pus cells and usually numerous multinuclear giant cells, the latter also containing the organisms.

As to symptomatology, in the pure skin type the general health is not affected. Usually the hands and face, including occasionally the

9. Oxford Medicine, New York, Oxford University Press, 1921, vol. 5, p. 408.

eyelids, are involved. The initial lesion is a slowly growing reddish papule or papulopustule, which bleeds easily and which exhibits at its border tiny abscesses containing the organism.

The systemic types usually begin with lesions of the skin and next exhibit pulmonary involvement, although the two may appear simultaneously and, rarely, the pulmonary involvement may be primary. The disease runs a subacute or chronic course with periods of improvement and exacerbation over a number of months or years. When generalized infection sets in there are evidences of pyemia with fever, chills, night sweats, loss of weight and strength and emaciation. There may be cough, pain in the chest and mucopurulent or bloody sputum, with occasional symptoms of laryngitis. Consolidation is present over the involved areas, and the entire clinical picture of the pulmonary infection closely resembles that of tuberculosis. This, indeed, is true of blastomycosis no matter where it is located.

There may be diarrhea, albumin and casts in the urine, anemia, splenic enlargement, leukocytosis, arthritis, pain and swelling of the joints, abscesses in the muscles and bones, as well as in the various abdominal and thoracic cavities and viscera, spondylitis and involvement of the eyes.

As has been suggested, the disease resembles tuberculosis in its various aspects more than any other condition. The diagnosis can always be made by demonstrating the blastomycetes in the lesions or the sputum.

For the skin form, the prognosis is rather favorable since perseverance in treatment usually leads to a cure. Rarely, the lesions may even heal spontaneously. More than 90 per cent of the generalized cases are fatal in periods ranging from four months to three years.

Stober's demonstration that mold growth in unhygienic dwellings may be a cause leads to the conclusion that good ventilation, lighting, drainage and other similar precautions may be factors in prophylaxis. Abrasions of the skin in the presence of decaying or moldy wood or other similar substances should have appropriate surgical attention at once.

Although rest, food and fresh air are of importance, by far the most reliable form of treatment, as first suggested more or less empirically by Bevan, is the internal administration of potassium iodide to the limit of tolerance. Doses of 300 or 400 grains (20 or 25 Gm.) or more a day of the saturated solution have been employed. Gilchrist has found improvement after the injection of a sterilized autogenous filtrate from living organisms. Stober has employed subcutaneous injections of the filtrate of whole blastomycetic cultures, with some success. Excision, curettage, superficial cauterization, drainage or aspiration of abscesses,

irrigation with 1 per cent copper sulphate or iodine and, most important, the use of the x-rays, have given the best results in the treatment of local lesions.

BLASTOMYCOSIS AS RELATED TO THE EYE

Blastomycosis involves the eyelids with surprising frequency. Wood [10] is of the opinion that one fourth of all cases affect the lids more or less. A much larger proportion show lesions in close proximity to the lids. Ricketts reported involvement of the lid in three of his cases, one of these resulting in ectropion. Wood, in 1904, reviewed thirty-five cases of blastomycosis and described in detail involvement of the lid in nine of these. Jackson,[11] in 1915, recorded two cases of involvement of the lid and called attention to the considerable distortion of the lids, which is a frequent sequel, and to the excellent prognosis under appropriate treatment.

It is noteworthy that the conjunctiva seems almost immune to infection with this organism. Wilder,[12] in 1904, also reported a case of marked involvement of the lid with resulting ectropion. Direct infection of the cornea is also rare but has been reported by McKee [13] and by Busse and Buschke. In both these cases a corneal ulcer developed which became infected with blastomycosis secondarily from the adjacent lesions on the lid. Even in such a case as this, which McKee reports, the conjunctiva, while inflamed and edematous, yielded no blastomycetes in the scrapings, whereas the corneal ulcers and the areas on the lid showed a large number.

Proved intra-ocular blastomycosis is among the greatest of rarities. Mention of this condition has been found only twice in all the literature reviewed. One case was reported by Churchill and Stober [14] in 1914 in which a puncture was made into the vitreous and pus was removed which contained blastomycetes. McKee mentioned a case in which Lundsgaard obtained the organisms from a hypopyon. It is significant, however, that at least in the latter of these cases and, judging from the report, probably also in the former, the organisms entered from anteriorly, i. e., through a corneal lesion. In other words, the infection of the eye was evidently introduced into the eyeball by contiguity and ulceration, and was not primarily intra-ocular or metastatic from some

10. Wood, C. A.: Ann. Ophth. **13**:92, 1904.

11. Jackson, Edward: Blastomycosis of the Eyelids, J. A. M. A. **65**:23 (July 3) 1915.

12. Wilder, W. H.: Blastomycosis of the Eyelid, J. A. M. A. **43**: 2026 (Dec. 31) 1904.

13. McKee, S. H.: Internat. Clin. **3**:50 (Sept.) 1926.

14. Churchill, T., and Stober, A. M.: A Case of Systemic Blastomycosis, Arch. Int. Med. **13**:568 (April) 1914.

other lesion in the body. Such a condition, indeed, cannot be found on record. I shall report such a case which I saw in consultation with Dr. Wayne H. May of Minneapolis. Much of the following information is taken from the autopsy record of Dr. N. H. Lufkin.

REPORT OF CASE

History.—A white man, aged 38, a Scandinavian, a resident of Iowa, had been well until Dec. 15, 1927, at which time he had a severe coid which left him with a chronic, persistent cough. On Jan. 1, 1928, he noticed a small sore on his left cheek which had the appearance of a blackhead. About February 12, pleuritis developed, which confined him to bed for a week. After this the pain subsided somewhat, but his general condition became worse, with dyspnea. Examination at this time revealed a pleural effusion on the left side, severe dyspnea and persistent cough. There were some slightly indurated ulcerations on the left cheek.

The patient was admitted to Eitel Hospital on May 5, 1928, and 2,000 cc. of fluid was withdrawn from the left side of the chest. The following day, 2,000

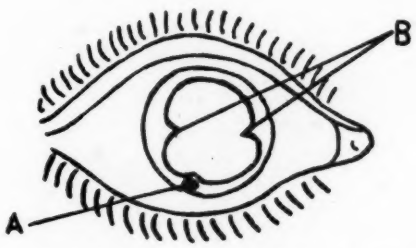

Fig. 1.—Appearance of iris on March 7, 1928: *A*, mass in iris; *B*, posterior synechiae.

cc. was again withdrawn. For a time he improved, and then acute iritis of the right eye developed. Pains developed in both knees. A hard lump was noticed in the lower portions of the left calf. A few days later, an abscess developed over the ribs in the lower portion of the thorax on the right side. The iritis became purulent, and the cornea was incised to evacuate the pus and relieve the discomfort. Abscesses developed in both legs and arms. There was a gradual decline until death, at which time there were a number of large superficial abscesses on his body which contained creamy pus. The maximum temperature during this period had been 101 F., with a minimum of 98.6 F. The pulse rate varied from 80 to 120. The white cell count was 16,500; tests of the urine were negative; the blood pressure was 100 systolic and 60 diastolic. Blastomycetes were isolated from the sputum, from suppurative material, from the abscesses and from material drained from the eye.

Ophthalmologic Examination.—I was first asked to see the patient on March 6, 1928. At that time he had had some discomfort in the right eye since coming to Minneapolis ten days previously. Trouble in the right side of the chest had been present for several months. Marked circumcorneal injection was present in the right eye; there was no increase in the tension of either eye. There had been some inflammation of this eye, with pain, for more than a week, but this had not become marked until the past few days.

A diagnosis of acute iritis was made and the customary treatment outlined. Posterior synechiae were found in locations corresponding to 3 and 9 on the clock dial. Also, there was found a small mass from 1 to 2 mm. in diameter, apparently in the substance of the iris at its periphery. This was situated far inferiorly and a little temporally, i.e., at about 7 on the clock. The cornea, sclera, conjunctiva and lids were normal. The left eye showed no evidence of involvement.

Course.—On March 8, the hyperemia was diminishing and as the pupil dilated further under stronger atropine, some hitherto invisible posterior synechiae became apparent, especially below, at 6 on the clock. The adhesion at 3 on the clock had given way, and the pupil at the nasal side now seemed free.

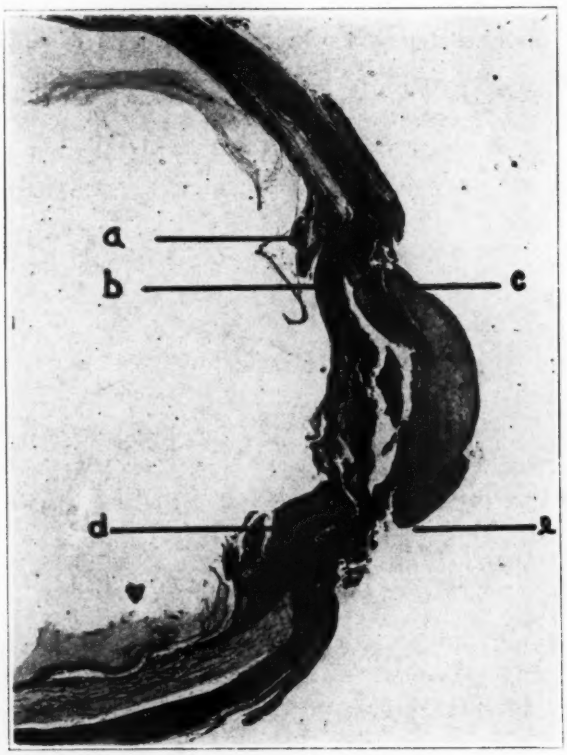

Fig. 2.—Anterior segment of eyeball under low magnification; *a*, ciliary body; *b*, iris; *c*, cornea; *d*, original mass in iris; *e*, site of corneal incision.

On March 10, the eyeground was examined and, while it was slightly indistinct, the fundus showed no definite pathologic change. On March 11, the mass in the iris had enlarged slightly. On March 12, the mass was partly covered with vessels inferiorly, and the following day it began to project into the anterior chamber and was steadily enlarging. The fundus now was very hard to see, because of changes in the media. On March 16, the mass was larger, projecting more into the anterior chamber, and had become definitely yellow. At this time it began to look like a tubercle, although the possibility of other pathologic involvement was also kept in mind.

On March 20, the mass began to open into the anterior chamber and a yellow exudate appeared. The following day it was larger, more deeply yellow and apparently breaking down.

On March 27, the mass had reached the posterior surface of the cornea. The eye had become a little more tender. Consultation at this time with several experienced ophthalmologists brought forth opinions which essentially concurred in the diagnosis of tuberculosis.

On April 8, the deposit in the anterior chamber had increased in size. The pupil had become partly covered by an inflammatory membrane. The eye was tender but soft.

On April 11, the patient presented several tender lumps scattered over the body and complained of pain in the legs.

On April 14, the eye was moderately tender. A large thoracic abscess was opened, and pus was removed for examination.

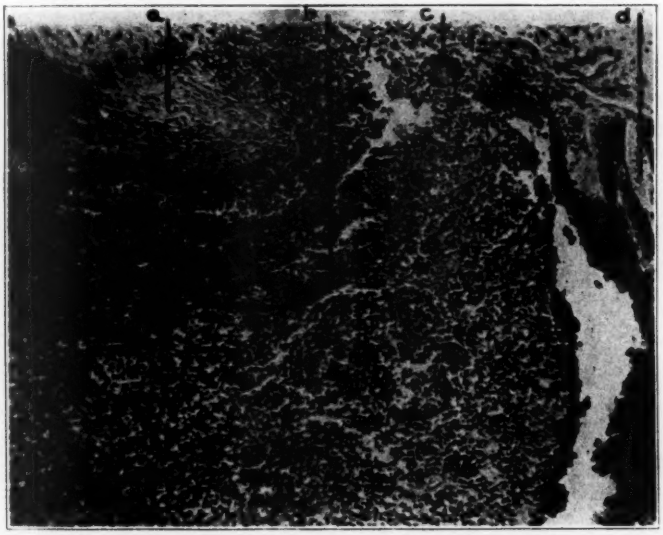

Fig. 3.—Root of iris, superiorly, under medium magnification (the slide has been reversed): *a*, corneal lamellae; *b*, giant cell in iris; *c*, giant cell; *d*, ciliary process.

On April 19, the patient's general condition was diagnosed as a fungus disease, but an intra-ocular condition of this kind due to a fungus seemed hardly to be considered, since no such case could be found in the literature.

On April 20, the eye had become very tender; the anterior chamber was full of pus and seemed to be "pointing" inferiorly.

On April 23, there was marked bulging at the lower part of the cornea, apparently from the extreme angle of the anterior chamber below. It was decided to make a small incision and to evacuate some of the pus gradually. This was done.

On May 2, blastomycetes were found in pus obtained from an abscess on the leg.

Under the strictest asepsis, a small quantity of pus was removed from the anterior chamber, smears were made, and a quantity was planted on Sabouraud's agar and in broth. Blastomycetes in pure culture were found in all specimens.

On May 14, after experiencing a good day, the patient suddenly became worse and died within a few hours.

At this point it is well to emphasize again the marked similarity between the mass in the iris observed in this case and a solitary tubercle as described in most textbooks. The mass here reported had unquestionably metastasized from some distant lesion and had become implanted at once in the substance of the iris. The manner of its development and growth, as well as the gross appearance at all times of the lesion of the eye (except possibly for the presence of iritis which is often absent from a solitary tubercle) and of the other lesions throughout the body were also characteristic of tuberculosis. The Wassermann test was repeatedly negative.

Autopsy.—The body was well developed and well nourished, weighing about 180 pounds (81.6 Kg.). The left pupil was 5 mm. in diameter and was regular. The right pupil was obliterated by a hypopyon. The cornea was thickened and

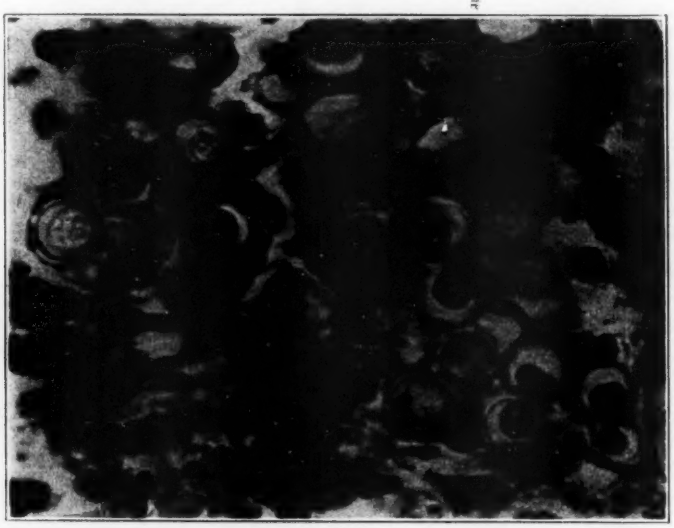

Fig. 4.—Characteristic appearance of blastomycetes at *b* in figure 2.

opaque. The eyeball itself was sunken and soft. There was a reddened patch 2 cm. wide and 3 cm. long on the left cheek. The superficial surface of this area was roughened, and its margins were deep red and raised. There was another patch at the right side of the nose beneath the inner canthus of the eye. This was about 1 cm. in diameter and was elevated and reddish, with a rough surface. There was another patch similar to this over the zygomatic process of the left cheek just beneath the eye.

There were abscesses of the left arm and forearm, of the right forearm and of both legs. From all of these a thick, yellowish-gray pus could be expressed. A large quantity of similar pus was evacuated from the left knee joint and from a mass on the right side of the anterior abdominal wall. The peritoneal surfaces were normal.

The left pleural cavity was almost completely obliterated by dense fibrous adhesions, from 0.5 to 1 cm. in thickness. There were numerous areas which

contained encapsulated fluid and pus. The right pleural cavity contained some serosanguineous fluid. The pericardial surface was covered with a fibrinous exudate. The heart muscle was pale, soft and flabby.

Because of the dense adhesions, the left lung was removed with great difficulty, leaving ragged and torn surfaces. It had a distinctly nodular feel on palpation. The cut surfaces were dotted with whitish miliary nodules. Numerous larger nodules were found, as large as 0.5 cm. in diameter. These contained definite pus. Pus was easily expressed from both the larger and the smaller bronchi. The right lung was not adherent to the parietal pleura in any portion and had a finely nodular feel throughout. Beneath the visceral pleura were seen numerous tiny whitish nodules covering all its surfaces. The cut surfaces revealed a similar infiltration with tiny miliary nodules. All lobes showed this generalized involvement. The spleen showed numerous small whitish nodules occurring both singly and coalescing into masses as large as 0.5 cm. in diameter. Cut surfaces of the liver and kidney presented a cloudy appearance with indistinct markings. The gross appearance of the eyeball has already been described.

Microscopic sections were examined by Dr. Walter E. Camp, who reported as follows: The cornea was greatly thickened and showed a perforation in its lower portions near the limbus. There was considerable chemosis. The corneal epithelium was somewhat edematous but otherwise normal. The stroma of the cornea showed marked edema and was infiltrated particularly in the posterior layers with many polymorphonuclear leukocytes. The corneal perforation was filled with an exudate of polymorphonuclear leukocytes, giant cells, iris pigment granules and blastomycetes. The anterior chamber and the iris angle were almost entirely obliterated by an exudate of polymorphonuclear leukocytes, blastomycetes and giant cells. The pigment in the epithelium of the iris was destroyed over large areas. In the central portion of the iris was a medium sized area of necrosis. In the superior portion of the cornea near the limbus, the corneal stroma was almost entirely replaced by an exudate similar to that described in the anterior chamber and iris. The ciliary body was practically normal.

The various layers of the choroid were normal with the exception of some perivascular infiltration of round cells. The retina showed two small areas of separation near the equator of the globe. The thickening of the iris was due to the infiltration of polymorphonuclear leukocytes, many of which were necrotic. The blastomycetes were much more numerous in the lower half of the iris. The organisms were of variable sizes, having a highly refractile, double-contoured capsule, surrounding a granular or dark-staining mass.

The diagnoses on the basis of the autopsy record were:

1. Blastomycosis of the skin, subcutaneous tissues, lungs, spleen, knee joint and eye.
2. Cloudy swelling of the heart, liver and kidneys.
3. Secondary bronchopneumonia.

Medical Arts Building.

ABSTRACT OF DISCUSSION

DR. PETER C. KRONFELD, Chicago: In my opinion, this is the first report of a case of endogenous, metastatic blastomycosis of the eye that has been published. Experimentally, a very similar clinical and anatomic picture was produced by intravenous injection of blastomycetes by Stock in 1908. He obtained lesions in the iris which looked clinically like tubercles and later on led to purulent exuda-

tion into the anterior chamber. Stock also observed metastatic retinochoroiditis after intravenous injection of blastomycetes into rabbits. The type of fungi which Dr. Schwartz has been dealing with in his case most likely was cryptococcus Gilchrist. The whole disease is usually called American blastomycosis. Dr. Schwartz's case represents a valuable addition to our knowledge of blastomycosis.

DR. VIRGIL J. SCHWARTZ, Minneapolis: I wish to thank Dr. Kronfeld for giving my case priority. I did not specifically say it was the first case of its kind on record but I was not able to find another, and I am pleased to hear that Dr. Kronfeld, who has done considerable work on blastomycosis, was not able to find one, either. The comparative rarity of systemic blastomycosis becomes at once apparent when it is recalled that fewer than fifty cases of this condition appear in the literature. In *The Journal of the American Medical Association* for June 21, Lewis, Carroll and Stryker [15] reported a case of blastomycosis of the prostate, epididymis and leg, there being also a number of characteristic lesions of the skin. The patient had apparently recovered, at the time of writing, following prostatectomy and the administration of large doses (a maximum of 120 drops daily) of sodium iodide. It will be interesting as well as gratifying if a permanent cure is effected in this patient since, as has been stated, less than 10 per cent of this type recover. The case presents no ocular involvement. The authors stated: "As far as we are aware, this is the only case reported of blastomycosis of the prostate gland." They will be interested to find that A. H. Montgomery has collected reports of five such cases, and Wade and Bel have found records of four, the latter probably being included in the former series. In my case an earlier diagnosis would have been desirable, but it would not have affected the ultimate result in any appreciable degree. The pulmonary involvement in particular was so extensive that a fatal outcome would have been inevitable even under the most heroic iodide medication. Nevertheless, the necessity for making a diagnosis as early as possible requires no emphasis, especially since the dosage of potassium iodide can be increased to a maximum only as rapidly as the tolerance permits, yet this maximum must be reached as early in the course of the disease as possible. Any case that presents the characteristic lesions of the skin already described, with or without evidence of coincident pulmonary involvement, must be suspected of blastomycosis, at least to the extent of examining the sputum and pus or scrapings from the lesions. By the time such a case reaches the ophthalmologist, the diagnosis will in all probability have been made.

15. Lewis, B.; Carroll, G., and Stryker, G. V.: Blastomycosis of the Prostate, Epididymis and Legs, J. A. M. A. **94**:1987 (June 21) 1930.

ROSETTE FORMATION IN THE EYES OF IRRADIATED HUMAN EMBRYOS*

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AND
DAVID WEXLER, M.D.
NEW YORK

The rosette denotes primarily a structure of characteristic appearance occurring typically in neuro-epithelioma (or neurocytoma) of the retina. The researches of Wintersteiner [1] virtually established the neuro-epithelium of the retina as the basis for the new growth, and defined the rosette as a palisade arrangement of neuro-epithelium about the external limiting membrane as a lumen. While many still believe that glial cells and their processes,[2] rather than nervous cells, furnish the material for the growth, Wintersteiner's conception of the rosette has remained almost universally accepted.

Rosettes in human eyes of other than pathologic significance have been found for the most part in fetuses from 5 to 8 months old or in infants. Seefelder [3] was the first to observe small rosettes in two fetuses, between the ganglion and inner nuclear layers, at the border of the optic nerve and retina in one case, and at the entrance of the nerve in the other. In the latter case, the rosettes were derived from the nuclear layers and mostly surrounded by nerve and glial fibers. In both cases the eyes were otherwise normally developed. A few years later, Seefelder [4] found poorly formed rosettes in a pocket formation consisting of rudimentary retinal tissue in the edge of the disk in a newly born child. Mawas and Magitot [5] found a few rosettes in a

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* From the Laboratories and Ophthalmological Division of Mount Sinai Hospital.

* Read before the American Academy of Ophthalmology and Otolaryngology, Chicago, Oct. 29, 1930; see discussion in Arch. Ophth. **5**:495 (March) 1931.

1. Wintersteiner: Das Neuroepithelioma, Retina, Berlin, Franz Deuticke, 1897.

2. Urra: Minute Structure of Glioma Retinae, Progresos de la clín. **27**:185, 1924.

3. Seefelder: Ueber Anomalien in Bereiche des Sehnerven und der Netzhaut normalen fötaler Augen, Arch. f. Ophth. **69**:226 and 463, 1909.

4. Seefelder: Pathologische-anatomischer Beitrag zur Frage der Kolobome, Arch. f. Ophth. **90**:129, 1915.

5. Mawas and Magitot: Arch. d'anat. micr. **14**:88, 1912.

fetus of 6 months. In 1913, Bertha Lindenfeld [6] described rosettes in the region of the nerve, together with folding in of the outer retinal layers, in two fetuses 6 and 7 months old, in which roentgen radiation had been used in the second month of pregnancy to secure early abortion. The eyes were normal in size for this age, and were in all respects normally developed. Lindenfeld did not attribute pregliomatous significance to these changes. Likewise, Gilbert,[7] in describing rosettes in a case with congenital cataract and retinal anomalies, stressed that "glioma" does not occur in maldeveloped eyes. In 1916, Pagenstecher [8] produced well formed rosettes in the retinas of rabbit embryos that had been subjected to the roentgen ray in utero. This experiment verified Lindenfeld's earlier observation regarding the formation of rosettes under the influence of the roentgen ray.

Leber [9] held retinal rosettes to be due to pathologic processes in fetal life. One of Seefelder's cases had a fetal iritis, the other a high grade degeneration of the retina. Jaensch [10] pointed out that the rosettes found at the edges of colobomas and in folded retinas of microphthalmic eyes (Wehrli [11]) are irregular in contour and occur in the portions of the retina that are greatly altered. While the rosettes in his own case were well formed and regular, with a sharply demarcated limiting membrane, there were evidences of a previous iridocyclitis. Professor Fuchs [12] placed the developmental defect responsible for rosettes in the time when greatest growth of the outer nuclear layer occurs after three months. In his opinion, the infrequency with which rosettes are found in postnatal life merely indicated that they undergo loss of their structure.

MATERIAL AND TECHNIC OF RADIATION

The material to be reported consists of five cases, each the issue of a pregnancy in which, for one indication or another, large doses of roentgen rays were applied in the second month with a view to termi-

6. Lindenfeld, Bertha: Beitrag zur Bildung rosettenartigen Figuren in der Netzhaut sonst normaler fötaler menschlichen Augen, Klin. Monatsbl. f. Augenh. **51**:443, 1913.

7. Gilbert: Ueber angeborenen Totalstar und Netzhaut Anomalien, Arch. f. Ophth. **81**:87, 1912.

8. Pagenstecher: Strahlwirkung auf das wachsende Auge: Experimentelle Untersuchungen über die Entstehung der Netzhaut Rosetten, 40 Versamml. Ophth. Ges., Heidelberg, 1916, p. 447.

9. Leber: Netzhaut, in Graefe-Saemisch: Handbuch der gesamten Augenheilkunde, ed. 2, Leipzig, Wilhelm Engelmann, p. 1787.

10. Jaensch: Falten und Rosettenbildungen in der Netzhaut, Arch. f. Ophth. **116**:464, 1925.

11. Wehrli: Ueber Makro- und Mikrogyrie Analoge Entwicklung Störungen der Retina, Arch. f. Ophth., 1915, vol. 90.

12. Fuchs: Ueber den anatomischen Befund einiger angeborener Anomalien der Netzhaut und des Sehnerven, Arch. f. Ophth. **93**:1, 1917.

nating the pregnancy. The first three ended at from three and a half to four months; the fourth, in which radiation was applied over the spleen as a therapeutic measure in myelogenous leukemia, terminated at six and a half months (210 mm. embryo); the fifth ended unusually late, at seven and a half months (260 mm. embryo). In the last two cases, viable fetuses were obtained after the artificial induction of labor, and each lived for one day. Dr. Robert T. Frank of the gynecological service cooperated with us in facilitating this study, and Dr. William Harris gave his attention to the details of the roentgen irradiation.

The anteroposterior diameter of the eyes of the last two embryos measured 11 and 13.5 mm., respectively, which corresponds with the

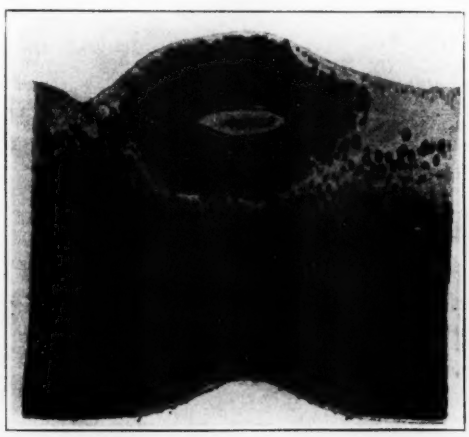

Fig. 1.—Rosette in embryo of rabbit irradiated experimentally. (From Pagenstecher: Versamml. d. Ophth. Ges., Heidelberg, 1916.)

normal dimensions for these ages. The three younger embryos having died in utero, some difficulty was found owing to partial necrosis of the

Technic of Roentgen Irradiation

Case	Date of Exposure, Mo.	Areas Treated	Skin Erythema Dose, No.	per Cent	Kilovolts	Milliamperes	Focal Distance, Cm.	Time, Min.	Size of Field, Cm.
1	2½	Anterior part of abdomen.	1	85	200	4	40	29.3	22 × 22
		Posterior field.....	2	85	200	4	40	29.3	24 × 24
2	2	Anterior part of abdomen.	1	85	200	4	40	30.4	21 × 21
		Posterior field.....	2	85	200	4	40	30.4	23 × 23
3	2	Anterior part of abdomen.	1	85	200	4	45	30.5	22 × 23
		Posterior field.....	2	85	200	4	45	30.5	24 × 25
5	2½	Anterior part of abdomen.	1	90	200	4	50	48.6	20 × 23
		Posterior field.....	2	90	200	4	50	48.6	25 × 24

4 Radiation over spleen for myelogenous leukemia; 18 exposures of 20 and 25 per cent skin erythema doses; labor artificially induced at from 5½ to 6 months; filter, ½ copper and ½ aluminum, all exposures

retina with dispersion of pigment through its layers. However, rosettes were seen in various stages of preservation. Those in case 1 were particularly well formed. In cases 4 and 5, the tissues were well preserved and allowed easier study. In the former case, a single rosette was found close to the ora serrata, and is studied in serial section. Case 5 showed conversion of large portions of the retina into rosettes to an extent not previously observed in embryos. In addition, there were found failure of fusion of the upper portion of the fetal cleft, practically total conversion of the upper end of the nerve and disk into rosettes, and, finally, faulty development of the ciliary processes and iris.

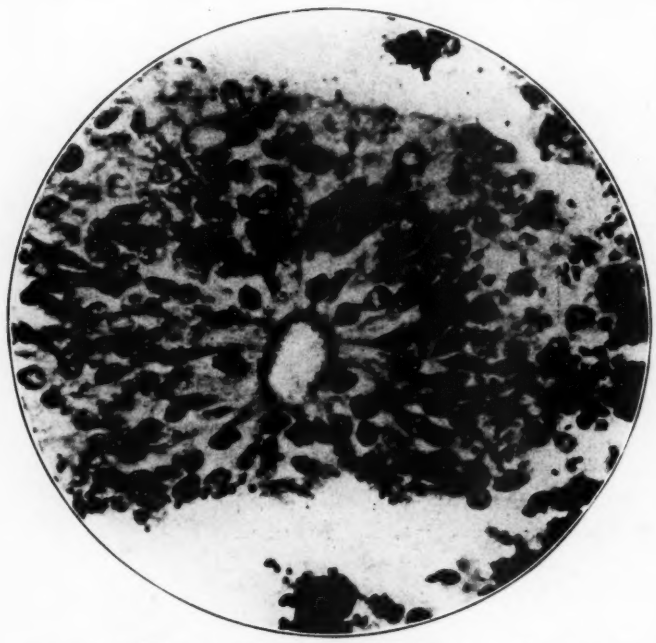

Fig. 2 (case 1).—Rosette in outer retinal layers. Many processes project through the limiting membrane. Oil immersion.

MICROSCOPIC OCULAR STRUCTURE

CASE 1.—A well preserved rosette is pictured in fig. 2. It consists of a mass of round and oval nuclei about a clear lumen, bordered by a poorly defined membrane, through which multiple fibrils project. There were clearly defined cell bodies next to the lumen, roughly quadrilateral in shape, with deeply staining oval nuclei. Apparently these cells bear the processes projecting through the membrane. In position and appearance they correspond to the "cone cells" in their early stage, while the filament represents probably the beginning of the outer limb of the cone (Mann[13]). The further developed cone cells with their processes in relation to a more definite external limiting membrane will be apparent in case 4.

13. Mann, I. C.: The Development of the Human Eye, New York, The Macmillan Company, 1928, p. 102.

CASE 2.—An arrangement of cells about a membrane is shown in figure 3*A*, in the midst of poorly staining retinal tissue.

CASE 3.—Here again (fig. 3*B*) a portion of rosette is shown with a deeply staining limiting membrane. Theoretically, according to Mann, a definite external limiting membrane is developed at this stage.

CASE 4.—A few cone and rod cells, with their processes, are depicted in figure 4*A* to show their elongated structure, the longer cell protrusions and the relation of the cells to those of the outer nuclear layer. This structure is probably duplicated in the rosette seen near the ora serrata (fig. 4*B*). From within out are the lumen, the protruding outer limbs of the cone and the rod cells, the external limiting membrane, the bodies of the cone cells with their oval nuclei and the cells of the outer nuclear layer. Finally, there is a clear space, and a few cells of the inner nuclear layer grouped loosely about the rosette.

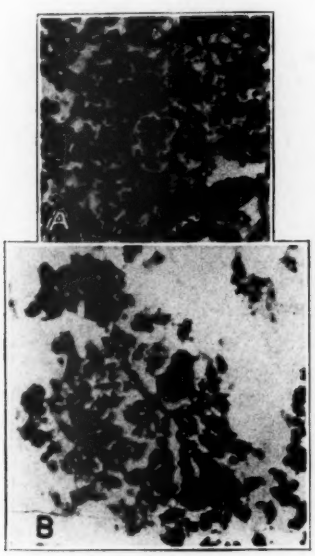

Figure 3

Figure 4

Fig. 3*A* (case 2).—A poorly stained rosette, partially necrotic. Oil immersion. *B* (case 3), portion of rosette. The limiting membrane is quite clear. Oil immersion.

Fig. 4 (case 4).—*A*, the bodies of the developing cone cells, *c*, project through the limiting membrane; a few rods; *r*, are also seen. *B*, rosette in nerve fiber layer close to ora serrata.

CASE 5.—*Optic Nerve.*—There is an apparent failure of fusion at one point in the upper part of the optic stalk, corresponding to the site of the disk. The cleft (fig. 5*A*) is lined on both sides with rosettes behind which is a cellular nerve fiber tissue. The cleft is not quite closed in figure 5*B*. In figure 5*C* at a lower level, there is complete formation of the disk and what purports to be the nerve, but which is in reality a fusion of elements similar to those lining the sides of the stalk seen in figure 5, *A* and *B*. Besides groups of rosettes, there are interlacing nerve

fibers, ganglion cells and a few pigmented epithelial cells, together with clear areas, such as *c*, in which the structure is fine and fibrillar, like that of the formed plexiform layer of the retina. There are no formed nerve bundles as in the fetal nerve of this age. A bit of tissue, bearing rosettes, has been detached and lies free in front of the pit.

Retina.—Rosette formation is present singly and in groups. Apparently only that portion of the retina close to the nerve and at a level horizontal with it is

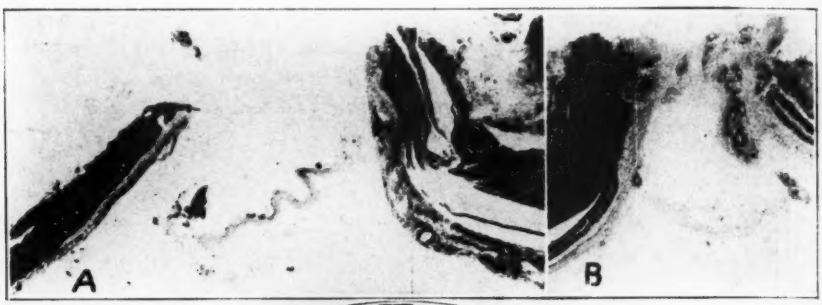

Fig. 5 (case 5).—*A*, nonunion of fetal cleft at site of nerve. The cleft is lined with rosettes and poorly differentiated retinal tissue. *B*, the cleft is not quite fused at a slightly lower level. *C*, rosette structure of nerve (fused fetal cleft). *c* is a clear area resembling the plexiform retinal layer.

affected. Rosettes are found in all of the retinal layers. Figure 6*A* shows a rosette extending from the inner nuclear layer through the nerve fiber layer. The cells of the rosette resemble closely those of the outer nuclear layer, while about it are loosely arranged cells resembling those of the rarefied inner nuclear layer. In figure 6*B* are multiple rosettes replacing the nuclear and nerve fiber layers.

Where definite nerve fibers can be seen they appear to turn their course abruptly behind the rosette to assume the position formerly occupied by the outer nuclear layer (fig. 6*C* and *D*). This is not a folding of the retina, but a genuine interchange in position of its layers. Figure 6*E* shows foci of cells in the presence of intact or slightly disturbed nuclear layers, where rosettes are incompletely formed or poorly differentiated. In figure 6*F* are groups of rosettes separated by intervals

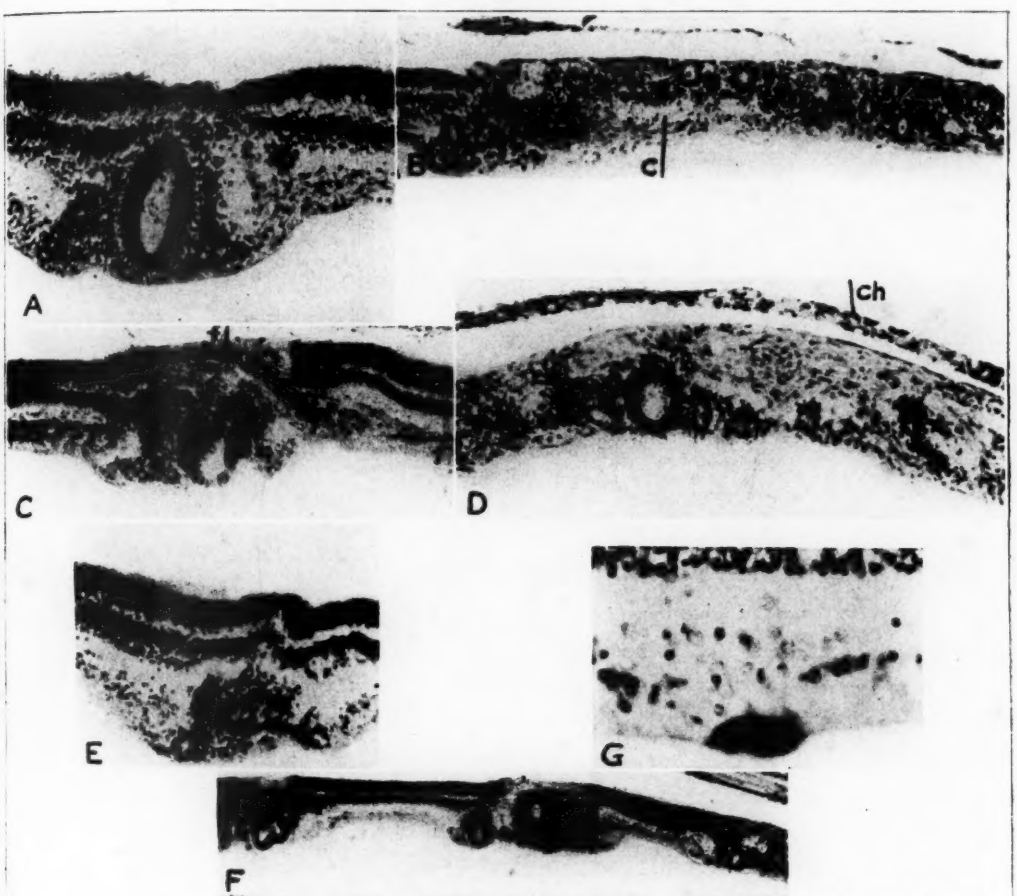

Fig. 6 (case 5).—*A*, a typical single retinal rosette. *B*, multiple retinal rosettes; *c*, the clear areas resemble the plexiform layer, *p*, of the retina. *C*, the deviation of the nerve fiber, *f*, posteriorly, behind the rosettes. *D*, total absence of layer structure, with rosette structure in front and nerve fibers behind, next to choroid, *ch*. *E*, poorly differentiated rosettes in anterior retinal layers. *F*, foci of rosettes occurring at intervals in the retina. *G*, nodule in retina at ora serrata.

of normal retinal tissue. At the ora serrata is a nodule (fig. 6*G*) projecting somewhat into the vitreous, composed of cells resembling those of the embryonal ganglion cell layer.

Uvea.—The choroid is normal.

The ciliary body contains a fair number of muscle bundles in its flat portion, but there are no processes on its surface. Only posteriorly near the ora serrata are there a few scantily developed pigmented folds. The iris is seen to spring from the margin of the optic cup, and is hardly more than a few layers of epithelium (fig. 7). The marginal sinus, *m.*, is the space between the two layers of the optic cup. Behind Descemet's membrane is a loose vascular tissue which in one or two places covers the edges of the rudimentary iris, but no iris stroma as such is made out. An anterior chamber can hardly be said to exist.

The lens, displaced from its normal site, was fully developed and free from abnormality.

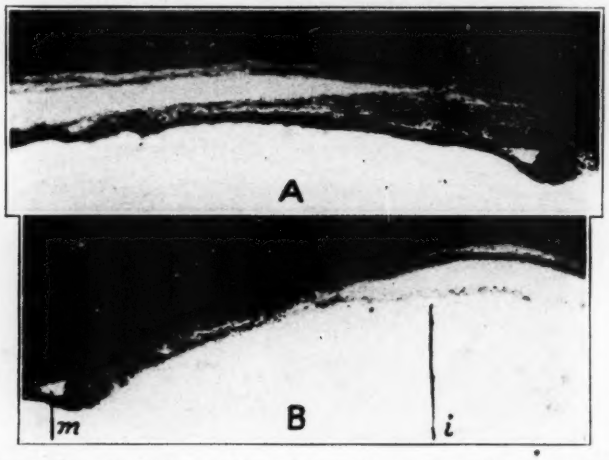

Fig. 7 (case 5).—*A*, ciliary body with rudimentary ciliary processes. *B*, iris, *i*, budding off from the edge of the optic cup; *m* is the marginal sinus.

COMMENT

The eyes of five embryos are presented, in each of which rosette formation occurred under the influence of roentgen irradiation in rather large doses. From this study and from the evidence contributed by Lindenfeld and Pagenstecher, it may be adduced that the development of rosettes is a specific result of this type of radiation on growing retinal tissue.

The rosette pictured in figure 2, from a 3½ to 4 months' embryo, represents the earliest stage in fetal life in which this structure has been described. While the specimen does not allow of distinction between the inner and outer neuroblastic layers, a rather systematic arrangement about a limiting membrane is evident, consisting of cells with oval nuclei. These are probably the outermost cells of the outer neuroblastic layer, while the filaments piercing the lining membrane correspond to the cone processes which represent the inner limb of the

definite cone. According to Mann, the external limiting membrane is present at this stage. The rosette in case 4 represents merely an advanced stage of cellular growth and differentiation involving the cone and rod cells, the cone filaments and the outer neuroblastic layer.

In addition to the formation of rosettes in case 5, there are a number of anomalous conditions which form interesting material from a developmental point of view. Granted that the rosettes are attributable to irradiation, one must still account for the persistence of the fetal cleft and for the rudimentary state of the iris and ciliary processes. One cannot entirely exclude the possibility of an inherently defective eye in which a severe stimulus such as the roentgen ray has caused secondary changes, as rosette formation. Lindenfeld emphasized that both of her cases showed no anomaly of development other than rosette formation. Still, one must seriously consider the anomalous conditions in this case, as well as the rosettes, as being due to the application of radiation at a critical period in development, namely, during the second month of fetal life. Moreover, in considering the unparalleled extent to which the retina and nerve are involved in the change to rosettes, one must bear in mind the massive dosage of the present day, as compared to the smaller doses which were prevalent at the time Lindenfeld reported her cases (1913).

The persistence of the cleft at one edge of the disk, lined with tissue bearing well formed rosettes, together with the almost total conversion of the nerve into groups of rosettes (fig. 5*c*), forms a picture that is without precedence in the literature. The rosettes described in and adjoining colobomatous areas are hardly as well formed or as numerous. Those in microphthalmic eyes, though often well formed, are likewise few, and accompany folding in of the outer retinal layers. The dimensions of the eye in this case are normal for this stage, although the possibility of microphthalmia, had the embryo grown to full term, cannot be excluded.

The anomalous conditions aside from the rosettes enumerated in the description, persistence of the cleft and rudimentary development of ciliary processes and iris speak in general for primary and secondary effects of the radiation. The initial effect may be considered to occur at the time of radiation, in this case during the second month. According to Mann, the fetal fissure has closed before the 20 mm. stage (7 weeks). It can be conceived that the application of an intense stimulus at this period inhibited complete closure. A similar influence apparently worked on the rest of the inner wall of the optic cup to the extent that the ciliary processes, which make their appearance in the third month, have retained a primitive state at 7½ months. Likewise, the iris is no further advanced than the 4½ months' stage, having just budded off the edge of

the optic cup. This cessation of further differentiation of portions of the inner wall of the optic cup could be considered a secondary effect of the radiation, owing to the latency and prolonged effect of the roentgen rays on tissues.

Professor Fuchs, in discussing Pagenstecher's [8] experimental work with rabbits, spoke of the excessive growth of the primitive outer neuroblastic layer as being responsible for rosettes. Undoubtedly, this layer, which furnishes the nuclei of the cones and rods, and finally differentiates into the outer nuclear layer, is responsible for the bulk of these structures. However, the multiplicity of rosettes throughout all retinal layers in the absence of a definite outer neuroblastic layer (fig. 6*B*) suggests a destructive, in addition to an alterative, influence of the radiation. There are only a mass of nuclei in place of the regularly formed layer. Most interesting is the turning of the nerve fiber layer behind the rosettes (fig. 6*D*). Its significance can only be speculated.

It will be seen, therefore, that the ectoderm, more specifically the inner wall of the cup, is involved in the changes enumerated. The choroid, the muscle of the ciliary body and the pupillary membrane (mesodermal portion of the iris) show no abnormalities. The eye is of normal size. Apparently, then, the mesodermal elements are intact.

It is interesting to note the condition of the lens in the face of such a large dose of roentgen rays. The cavity of the lens vesicle is filled by the primary lens fibers during the sixth week. Probably, the lens was normal because it was fully formed and not attacked during a critical stage in its development. Further applications of roentgen rays during later periods might have caused defects comparable to those noted in laboratory animals, in which opacities develop under the influence of small doses of roentgen rays repeated at intervals during embryonic life.

The case under consideration presents more than theoretical interest as regards a possible relationship to neurocytoma. Deep roentgen therapy has been used with some success in the treatment for neurocytoma. There is, then, the strange coincidence of the same physical agent first evoking rosettes and then being responsible for the destruction of this structure, which contributes an important if not basic feature of the new growth, in the first instance a stimulating, in the second, a destructive, influence. The presence of anomalies in this case detracts from the possibility of tumor formation in the event the embryo had survived, since it is virtually established that neurocytoma does not develop in anomalous eyes.

THE PARACENTRAL FIELD IN EARLY GLAUCOMA*

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This paper presents data on the scotomas found to be typical of incipient glaucoma. A study of the characteristics of the first perimetric symptoms of glaucoma should furnish information of value in making an early diagnosis. In this investigation it was found that in the first stages of its development, the arcuate scotoma known as the Bjerrum sign frequently occurs as an isolated blind area not connected with the normal blind spot. When no absolute scotoma could be detected, it was often possible to map an area in which the test object was visible but appeared dimmer or darker than in the surrounding areas. As Samojloff had previously shown, these early scotomas could be made to disappear within a short time if pilocarpine was instilled into the eye.

In order to obtain cases in the earliest possible stages, examinations were made at intervals of a group of patients having normal visual fields when first examined but in whose visual fields changes characteristic of glaucoma might, nevertheless, develop at some future time. The majority of these had primary glaucoma in one eye only, making it probable that glaucoma would later develop in the eye chosen for study in this investigation. Others had shown evidence of intra-ocular tension slightly above normal or of a possible beginning glaucomatous cup in the eye studied, but pathologic changes had not yet developed in the visual fields. Others showed no definite signs of glaucoma in either eye, but were included because of certain indications of incipient glaucoma or of conditions predisposing to glaucoma, such as shallow anterior chambers, nerve heads showing a possible early glaucomatous cupping, complaints of occasional blurred vision or of the seeing of colored haloes around lights, etc. A few cases of established glaucoma in an early stage were also included.

This group of patients came to the clinic at frequent intervals for routine examinations of the peripheral fields, tension and fundus. In addition, a careful search for scotomas was made, first at intervals of six months, and then more frequently when the results indicated the slightest evidence of pathologic change. In every case the examination of the fundus was made by the same person in order that the transition from a normal physiologic cup to an early glaucomatous cup might be

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detected at the earliest possible stage. The tensions were measured in most cases with the Schiötz tonometer, and the results expressed in terms of the new corrected scale. In a few instances the Souter tonometer was used. The same instrument was, however, employed throughout the study of an individual case.

Of the forty-four patients studied, twenty-seven have as yet shown no signs of pathologic changes in the visual fields, but since practically all were using pilocarpine regularly as a preventive, it is to be expected that in many cases the onset of glaucoma would be prevented or postponed. It is possible, moreover, that the use of colored stimuli and other methods of increasing the sensitivity of detecting scotomas, such as those suggested in an article by Ferree and Rand,[1] and later investigated experimentally by Ferree, Rand and me,[2] might have revealed pathologic changes in the fields of some of the patients found to be normal. In the present study, however, the investigation was confined to the use of small white test objects only. In all but a few cases the search for scotomas was made on the tangent screen of the Ferree-Rand perimeter.[3] The method of illuminating this instrument is such that, by shifting the perimeter arm so that it lies in the meridian under investigation, it is possible to maintain at all times an illumination of 7 foot-candles of artificial daylight on the test object and the surrounding field. The instrument is also provided with a means for controlling accurately the fixation of the eye and its distance from the screen. Because the Ferree-Rand perimeter was not always available, in several instances a black cloth screen, placed at a distance of 1 meter from the patient, was substituted. The meter tangent screen was illuminated from a nearby window, but no attempt was made to control the intensity or the evenness of the illumination. The provisions for maintaining the fixation of the eye and its distance from the screen were also less satisfactory than those of the other instrument. For these reasons the results obtained with the meter tangent screen are used only to supplement the data obtained with the screen of the Ferree-Rand perimeter. The scotomas indicated in the accompanying charts were all obtained with the latter instrument.

The determination of the limits of the blind spot and the search for scotomas were made with a white stimulus subtending a visual angle

1. Ferree, C. E., and Rand, G.: Methods for Increasing the Diagnostic Sensitivity of Perimetry and Scotometry with the Form Field Stimulus, Am. J. Ophth. **13**:118, 1930.

2. Ferree, C. E.; Rand, G., and Sloan, L. L.: Sensitive Methods for the Detection of Bjerrum and Other Scotomas, Arch. Ophth. **5**:224 (Feb.) 1931.

3. The perimeter was loaned by the Bausch and Lomb Optical Company for use in this investigation.

of 7 minutes. In order to obtain this value of visual angle the test object used at 33 cm. was 0.7 mm. in diameter, and that used at 1 meter was 2 mm. in diameter. Test objects subtending visual angles smaller than 7 minutes are occasionally of value. It is my experience, however, that in many cases it is impossible to detect the presence of a scotoma of the Bjerrum type with a test object smaller than 7 minutes owing to the fact that the peripheral limits of the field for this small test object lie in the region near the blind spot. In such cases, although one may suspect the presence of a Bjerrum scotoma, it cannot be mapped since its outer limits merge into the peripheral field. When no absolute scotoma can be detected with a 7 minute white test object. I have found it more feasible to search for a relative scotoma (i. e., a region in which the test object appears dim, but is still visible) than to substitute a smaller test object.

The results obtained are considered under the following headings. In section 1, cases are discussed in which an arcuate scotoma is found encircling the fixation point, similar to those described by Bjerrum, Seidel and others, but differing from them in that the scotoma is separated from the blind spot by an area in which the test object is visible. This type of scotoma is likely to be overlooked because some perimetrists assume that if the blind spot is mapped with a very small stimulus the existence of a Bjerrum or Seidel sign is made evident by an enlargement of the blind spot at its upper or lower border. It is obvious, however, that if the scotoma is separated from the normal blind spot by even a very narrow area in which the test object is visible, it will not be discovered by this procedure. In section 2, cases are described in which with a small white test object no absolute scotoma can be detected but in which it is possible to map a relative scotoma, i. e., an area in which the test object appears dim. In section 3, cases are considered in which scotomas are found to disappear or to decrease appreciably in size shortly after pilocarpine is instilled into the patient's eye. It is suggested that in cases in which the only evidence of glaucoma is the presence of an early stage of the Bjerrum type of scotoma, the fact, pointed out previously by Samojloff, that the scotoma disappears or decreases in size when pilocarpine is administered, may help to make the diagnosis of glaucoma more certain.

1. ABSOLUTE SCOTOMAS ISOLATED FROM THE BLIND SPOT

The occurrence of an arcuate scotoma of the Bjerrum type which is isolated from the blind spot has been discussed by others. Sattler,[4] in a study of the visual fields in glaucoma reported in 1912, found

4. Sattler, C. H.: Ueber das Gesichtsfeld bei Glaukom, Ztschr. f. Augenh. 27:33, 1912.

twenty-three cases of arcuate scotoma, in all but one of which the scotoma was connected with the blind spot; in this one case the scotoma began at the 45 degree meridian in the upper temporal field and extended to the upper nasal field where it merged with a nasal step. Peter [5] stated that the Bjerrum sign frequently begins as a detached area above or below the point of fixation. Traquair,[6] in speaking of the Bjerrum scotoma, said: "Occasionally the curved defect may be found isolated and unconnected with the blind spot, though occupying a curve which, if continued, would traverse it. Probably, however, thorough quantitative examination would in most cases show the connection of the defect with the blind spot though by no means necessarily in all. In some well developed examples with absolute defect, a narrow band of retained field may remain for some time at the edge of the blind spot separating it from the scotoma. It is not at all uncommon to find the caecal end of an arcuate scotoma less dense than the peripheral end." Thomasson,[7] however, differed with this view: "In my experience an isolated scotoma is never an early manifestation of glaucoma, all early scotomata being attached to the blind spot. Late in the disease, however, isolated scotomata do appear in various portions of the remaining visual area."

In this investigation there were nine instances in which scotomas separated from the blind spot were detected. The three cases of relative scotoma are described in the next section. The six cases of absolute scotoma are described as follows:

Case 1.—A patient, aged 59, had absolute glaucoma, probably simplex, in the right eye. In the left eye there was no evidence of tension above normal limits. The nerve head showed a wide deep cup extending to the temporal and lower borders. There was possibly some atrophy. The peripheral field for form stimuli and central vision were normal.[8]

Scotometric Observations.—Left Eye: In September, 1928, there was an absolute scotoma in the upper field which extended from the vertical meridian toward the blind spot, but which was separated from the latter by a relative scotoma, i. e., an area in which the test object was visible but indistinct. The scotoma was mapped on the tangent screen at a distance of 1 meter with a white test object subtending a visual angle of 3.5 minutes. In April, 1929, under the same condi-

5. Peter, L. C.: A Simplified Conception of Visual Field Changes in Chronic Glaucoma, Arch. Ophth. **56**:337 (July) 1927.

6. Traquair, H. M.: An Introduction to Clinical Perimetry, St. Louis, C. V. Mosby Company, 1927, p. 97.

7. Thomasson, A. H.: The Development of the Glaucoma Scotoma, Arch. Ophth. **56**:319 (July) 1927.

8. Since practically all the patients had normal peripheral fields for form stimuli and normal central vision, throughout the rest of this paper no specific mention will be made of the peripheral fields and the central vision when the form field was normal and the vision 20/20 or better.

tions this scotoma was found to be continuous with the blind spot. There was, in addition, a small isolated scotoma in the lower field. At the time these scotomas were mapped, the patient had not used pilocarpine for twenty-four hours. After 3 drops of a 2 per cent solution of pilocarpine had been instilled at ten minute intervals the scotoma was again mapped and was found to have shrunk to approximately one-half its former width. (Instances of the effect of pilocarpine in reducing the area of a scotoma are described in more detail in a later section of this paper.) In June, 1929, absolute scotomas of the annular type shown in chart 1 were found in both the upper and the lower visual fields. As may be seen from the chart, both were separated from the blind spot by very narrow areas in which the test object was visible. The scotomas extended to the horizontal meridian in the nasal field; they did not meet, but were separated by a narrow region in which the test object became visible once more.

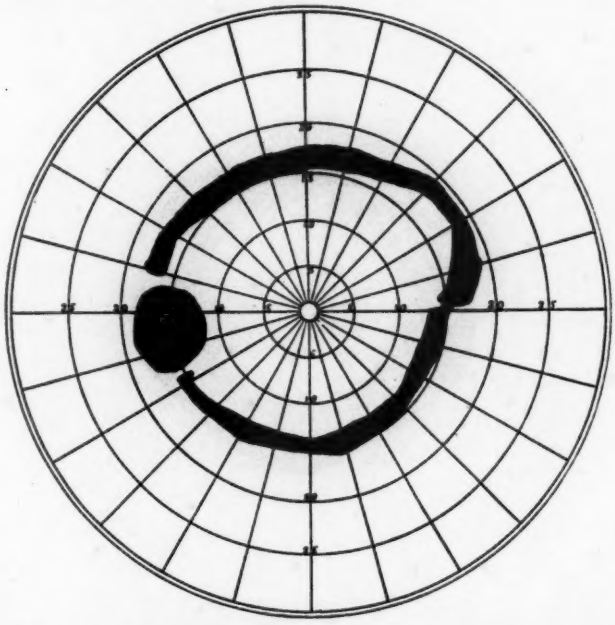

Chart 1 (case 1).—Area of scotoma in left eye mapped on June 24, 1929, by means of a white test object, subtending a visual angle of 7 minutes. (The same test object was also used for the following charts.)

Case 2.—A patient, aged 29, had marked cupping and atrophy of the disk in the left eye. Vision was nil. Tension was 32 (Souter) (12 or less is normal). On March 29, 1929, beginning glaucomatous cup was observed in the right eye. Tension was 22 (Souter). An increase in myopia was noticed. Intensive treatment with pilocarpine was prescribed. On May 6, tension was 14 (Souter).

Scotometric Observations.—Right Eye: On March 29 and April 11, relative scotomas were found in the lower field with a 10.5 minute white test object on the tangent screen, 1 meter distant. The upper field also showed a relative scotoma on March 29 which could not be detected on April 11. On May 6, the lower field showed an absolute scotoma extending from the normal blind spot, and the upper

field a similar scotoma separated from the blind spot (chart 2). In the center of the latter scotoma there was a small area in which the test object was visible. These were mapped on the Ferree-Rand screen with a 7 minute test object.

Case 3.—In June, 1928, established glaucoma, with marked cupping and changes in the fields, was noted in the right eye. In the left eye tension was 48 (Schiötz). There was a normal physiologic cup. Iridectomy was performed. In spite of operation, tension remained between 27 and 35 during 1928 and 1929.

Scotometric Observations.—Left Eye: On May 31, 1929, a relative scotoma was found in the lower visual field with a 7 minute white test object on the Ferree-Rand screen. On July 12, a smaller absolute scotoma was found with the same test object on the meter tangent screen. The scotoma was separated from the blind spot by an interval equal approximately to the height of the blind spot

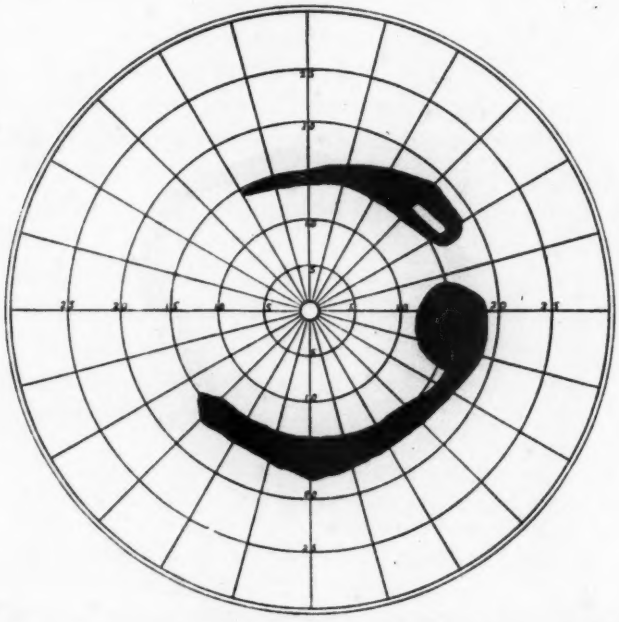

Chart 2 (case 2).—Area of scotoma found in right eye on May 6, 1929.

itself. At the time this scotoma was mapped, the patient had discontinued the use of pilocarpine for twenty-four hours and had a tension of 35 (Schiötz) in this eye. After the scotoma had been mapped, 1 drop of a 2 per cent solution of pilocarpine was instilled, and the fields were again tested after an interval of forty-five minutes. The scotoma was found to have shrunk to approximately one-fourth its former length. The patient was then examined with the Ferree-Rand tangent screen. A relative scotoma joining the blind spot and forming a complete ring was found. The small absolute scotoma found on the screen at 1 meter was also present.

Case 4.—While a patient was in the hospital for enucleation of the left eye for absolute glaucoma she had an acute attack of glaucoma in the right eye which subsided promptly when pilocarpine was instilled. After this attack the nerve head appeared slightly pale, but was in other respects entirely normal. The tension remained between 15 and 20 (Schiötz).

Scotometric Observations.—Right Eye: On March 8, 1929, an absolute scotoma was found in the upper field with a 7 minute white test object on the tangent screen at 1 meter. The scotoma was separated from the blind spot by an interval equal approximately to the height of the blind spot itself and extended almost to the vertical meridian. On March 22, under similar conditions, only a small oval scotoma, approximately one-fourth the area of the previous one, was detected. On July 1, a relative scotoma continuous with the blind spot was located in the upper field, with a 7 minute white test object on the Ferree-Rand tangent screen. An absolute scotoma could not be detected.

CASE 5.—A patient had shallow anterior chambers. The nerve heads were normal. Haloes had occasionally been seen around lights. No tension above normal was detected.

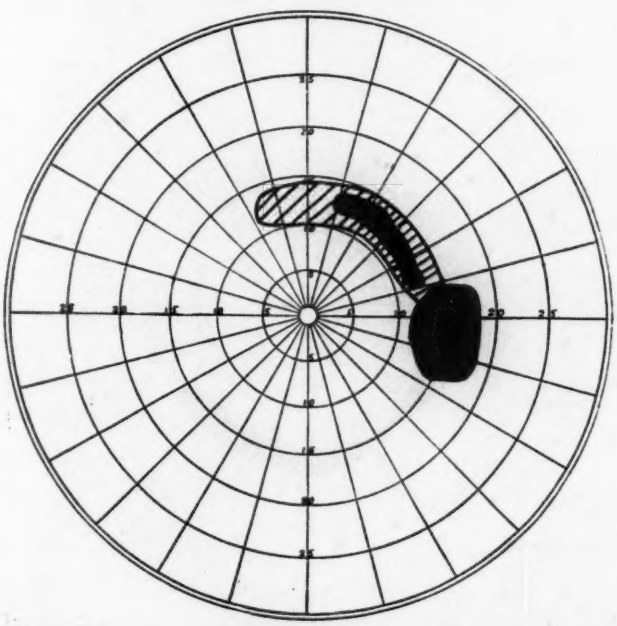

Chart 3 (case 6).—Area of scotoma found in right eye on May 10, 1929. In this and the following charts the black area indicates absolute scotoma, and the cross-hatched area, relative scotoma.

Scotometric Observations.—On Jan. 16, 1929, an absolute scotoma continuous with the blind spot was found in the lower visual field with a 7 minute test object at 1 meter. On January 23, there was no trace of this scotoma. On April 18, under the same conditions, a similar scotoma was found, separated from the blind spot by a narrow region in which the test object was visible. On both occasions on which the scotoma was mapped, it disappeared completely one hour after 2 drops of 2 per cent solution of pilocarpine had been instilled into the eye.

CASE 6.—A patient had absolute glaucoma in the left eye. Between January and July, 1929, tension varied between 19 and 31 (Schiötz) in the right eye. In August it rose to 42. In March the nerve head showed cupping slightly indicative of glaucoma.

Scotometric Observations.—Right Eye: In this case, as in the previous ones, there was an absolute scotoma separated from the blind spot. In this instance there was also a larger relative scotoma which surrounded the absolute one and joined the blind spot. These scotomas (chart 3) were found on May 10, 1929, several months before a definitely pathologic tension was detected.

In these six cases the scotomas described occurred in conjunction with other indications of glaucoma. In five of the six cases, moreover, primary glaucoma in an advanced stage was present in the other eye. It seems reasonable to suppose, therefore, that scotomas of the characteristic shape of those described by Bjerrum, but differing from the latter in that they are not continuous with the blind spot, are forms of this scotoma frequently found in the early stages of glaucoma. This tendency toward a preservation of the functioning of the retina near the papilla is also illustrated in the following case.

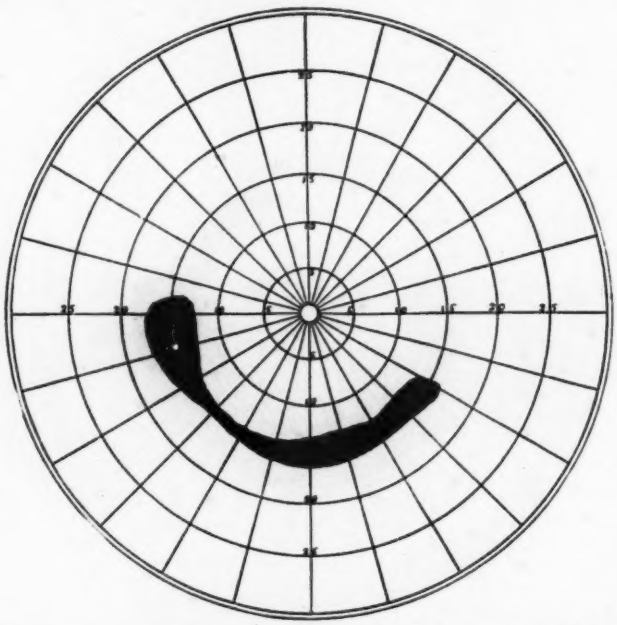

Chart 4 (case 7).—Area of scotoma found in left eye on May 27, 1929.

CASE 7.—A patient had advanced glaucoma of the simplex type in the right eye. In the left eye, under the instillation of pilocarpine, the tension remained around 24 (Schiötz). The optic disk was normal.

Scotometric Observations.—Left Eye: The arcuate scotoma shown in chart 4 was mapped with a 7 minute white test object. Although it was continuous with the blind spot, it is included here because the extreme narrowness of the scotoma as it leaves the blind spot suggests that if it had been mapped at a slightly less advanced stage or perhaps with a somewhat larger test object, it might have demonstrated itself as an isolated scotoma similar to those previously described.

2. RELATIVE SCOTOMAS

In the preceding section, mention was made of a number of instances in which relative scotomas were found. In case 6, for example, an

isolated absolute scotoma was found surrounded by a relative scotoma of greater extent which joined the blind spot. The importance of searching for these relative scotomas is shown by the number of times they can be found when no absolute scotoma can be detected with the smallest feasible white test object. In such cases if the patient is asked to indicate any marked change in the appearance of the test object, it is frequently possible to map a region in which it appears dimmer or darker than in the surrounding portion of the visual field. The presence of such an area can best be detected if the test object is passed slowly along one of the radial lines of the campimeter screen from the periphery toward the center. If the patient states that it grows gradually brighter as it approaches the center, one may consider that meridian normal

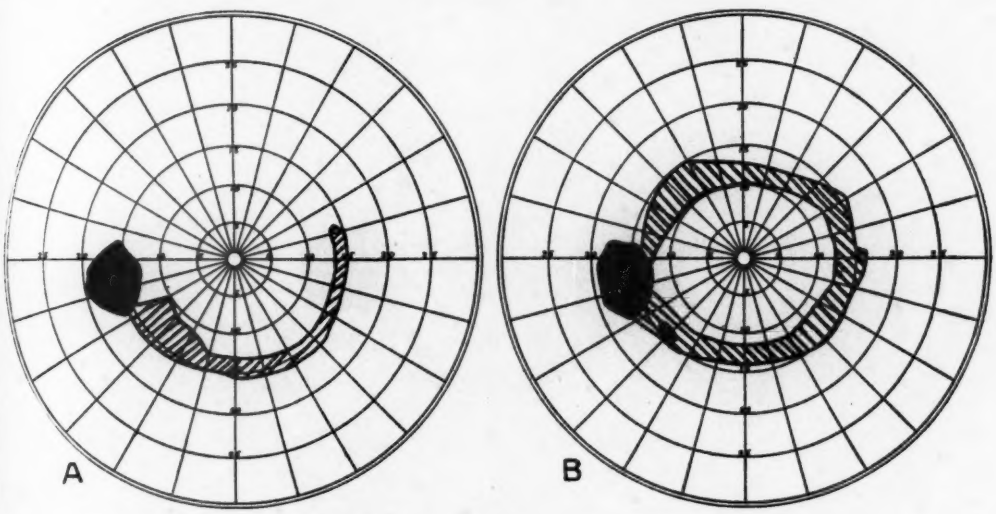

Chart 5 (case 3).—Area of scotoma found in left eye; *A*, on May 31, 1929, and *B*, on July 12, 1929.

and proceed to test the other meridians in a similar fashion. If, however, the patient notices a point at which the test object becomes dimmer or darker as it approaches the center and another point at which it becomes brighter again, one may suspect the presence of relative scotoma. The points at which the change in the appearance of the test object takes place are recorded. The test may then be repeated by moving the test object out from the center along the radial line and obtaining a second determination of the limits of the scotoma. By making such determinations at suitable intervals the whole scotoma can be mapped out. It is obviously more difficult for the patient to detect a change in the appearance of the test object than it is for him to note its complete disappearance. Consequently, it is important that, in the region studied,

the screen be evenly illuminated. If it is not, subjective changes in the brightness of the test object may be confused with changes due to unevenness of illumination.

Cases 2 and 3 of the previous section offer examples of the presence of relative scotomas in established glaucoma. In the former case, a scotoma of this type was found in the lower visual field on two occasions (March 29 and April 11, 1929). On May 6, an absolute scotoma was found in the same region. In the latter instance (case 3), the relative scotomas shown in chart 5 were found on May 31 and July 12. As was stated in the previous section, in spite of an operation in June,

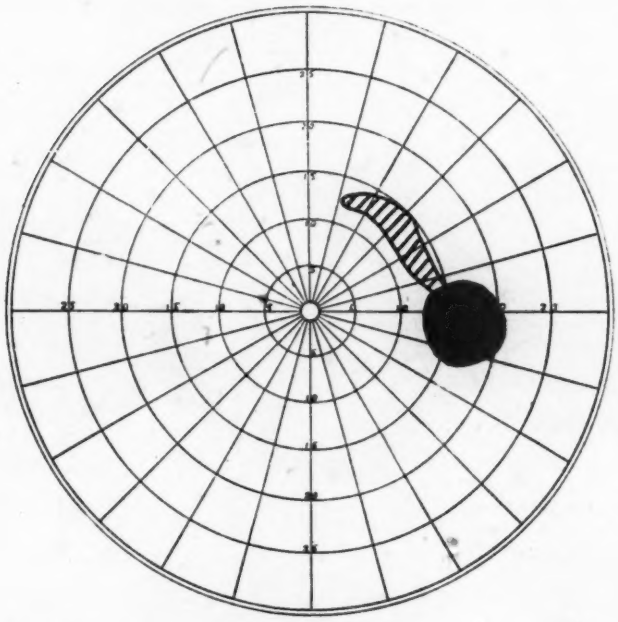

Chart 6 (case 4).—Area of scotoma found in right eye on July 1, 1929.

1928, the tension was not reduced to normal, but varied between 27 and 35 (Schiötz). On July 12, the tension, taken before the fields were examined, was 35 (Schiötz). An absolute scotoma was found which disappeared almost completely forty-five minutes after 1 drop of a 2 per cent solution of pilocarpine was instilled, leaving the relative scotoma shown in chart 5*B*. Another example of a relative scotoma in a case of established glaucoma is shown in chart 6. The history of this patient (case 4) was given in the previous section.

In the next two cases also, a relative scotoma occurred in conjunction with other symptoms which were probably sufficient to establish the diagnosis of glaucoma.

CASE 8.—In a patient, aged 61, the tension, nerve heads and peripheral fields were normal in both eyes on Dec. 31, 1928. On April 29, 1929, tension was 20 (Schiötz) in the right eye and 30 in the left. The optic disks showed a slight indication of glaucomatous cupping, especially in the left eye. In October, 1929, a nasal step of 15 degrees, extending from 45 to 60 degrees, was found in the left eye, with a 30 minute white test object.

Scotometric Observations.—Left eye: On Dec. 31, 1928, no scotoma, absolute or relative, could be found with a 7 minute white test object on the screen at 1 meter. The limits of the field for this test object, however, showed a slight indication of a nasal step. On April 11, 1929, the observations were the same as in December, 1928. In June, 1929, the relative scotoma shown in chart 7 was found.

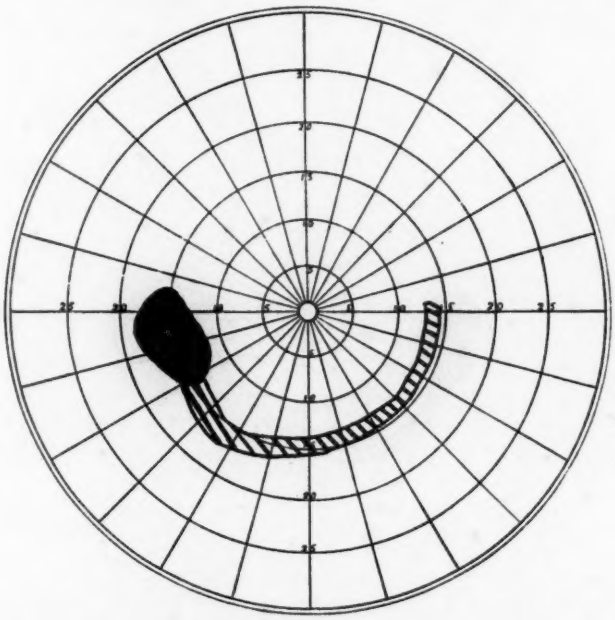

Chart 7 (case 8).—Area of scotoma found in left eye on June 28, 1929.

CASE 9.—A patient had advanced glaucoma simplex in the right eye. An absolute Bjerrum scotoma in the upper field was mapped with 1 degree white test object. Glaucomatous cupping was present. Tension was never greater than 31 (Schiötz). In the left eye, definite glaucomatous cupping was noted in June, 1928. Tension was never greater than 30 (Schiötz). Treatment with pilocarpine had been given since February, 1928.

Scotometric Observations.—Left Eye: An absolute Bjerrum scotoma was found in the upper field in June and in November, 1928. This was much less definite in March, 1929. In May, 1929, there was no trace of the scotoma either on the Ferree-Rand screen or on the tangent screen at 1 meter. In June, 1929, a small relative scotoma, shown in chart 8, was found in the lower field. The test object occasionally disappeared completely, but it was visible though indistinct throughout the greater part of the area mapped.

In two of these cases a later test showed that the relative scotoma had increased in size; in a third case it had become absolute instead of relative. An advance in the defect, however, was not always found. In two instances there was, on the contrary, evidence of recovery, since scotomas that had previously been absolute were on a later test found to be relative.

In the eight cases to follow, relative scotomas were demonstrated in patients in whom other indications of glaucoma were slight or lacking entirely. In case 5, absolute scotomas were found on Jan. 16 and April 18, 1928, as described in the previous section. In November, 1929,

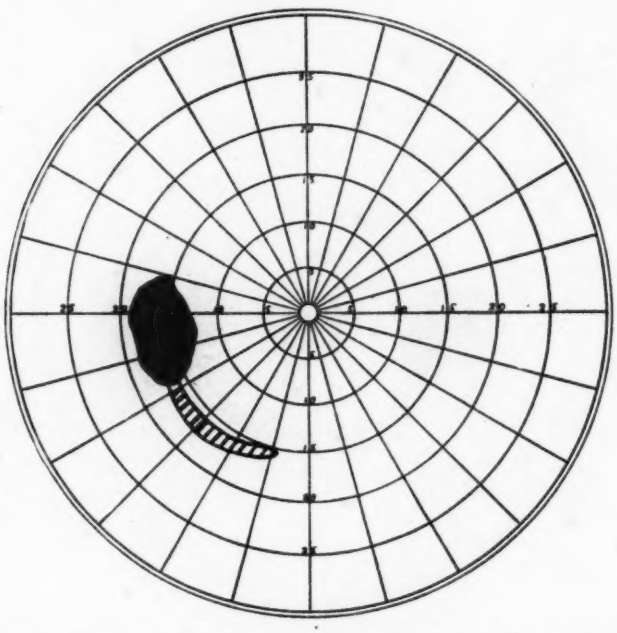

Chart 8 (case 9).—Area of scotoma found in left eye on June 18, 1929.

relative scotomas were found in both the upper and the lower visual fields (chart 9). The test object occasionally disappeared completely in the region indicated, but it was not possible to map an absolute scotoma showing definite boundaries.

Case 10.—A patient, aged 52, had chronic congestive glaucoma in the left eye; he had undergone iridotasis. In the right eye the nerve head was normal. Tension was normal. The anterior chamber was slightly shallow. Pilocarpine was used occasionally when needed to relieve pain in the eye.

Scotometric Observations.—On April 18, 1929, a relative scotoma was found in the lower visual field on the tangent screen at 1 meter. This scotoma extended from the blind spot to a point slightly beyond the vertical meridian. One hour after 2 drops of a 2 per cent solution of pilocarpine had been instilled, the scotoma

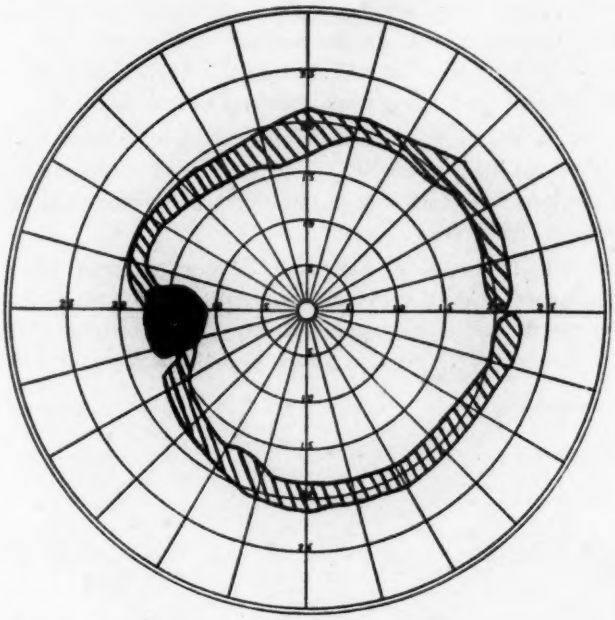

Chart 9 (case 5).—Area of scotoma found in left eye on Nov. 15, 1929.

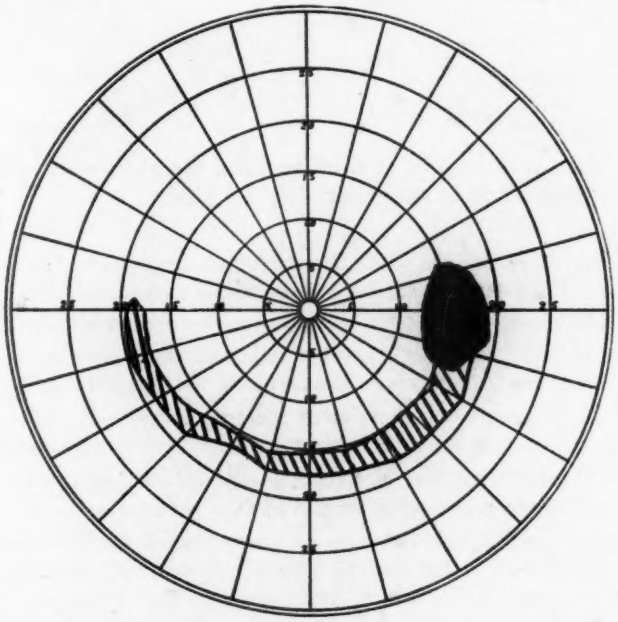

Chart 10 (case 10).—Area of scotoma found in right eye on June 27, 1929.

had disappeared except for a very small extension of the lower portion of the blind spot. On June 27, the relative scotoma shown in chart 10 was mapped on the Ferree-Rand tangent screen. In this case the scotoma formed a complete semicircle extending to the horizontal meridian in the nasal field. No change in the extent of the scotoma took place when pilocarpine was instilled.

CASE 11.—A patient, aged 36, complained of night blindness and headaches, worse in the right eye than in the left. The nerve head of the right eye was paler than that of the left, and there was a suggestion of glaucomatous cupping. Tension was normal in both eyes.

Scotometric Observations.—In February, 1928, an absolute Bjerrum sign was mapped in the upper field of the right eye with a 10.5 minute test object at 1 meter. When the patient was examined in May, 1928, October, 1928, and April, 1929, however, no absolute or relative scotomas could be found in either eye with a

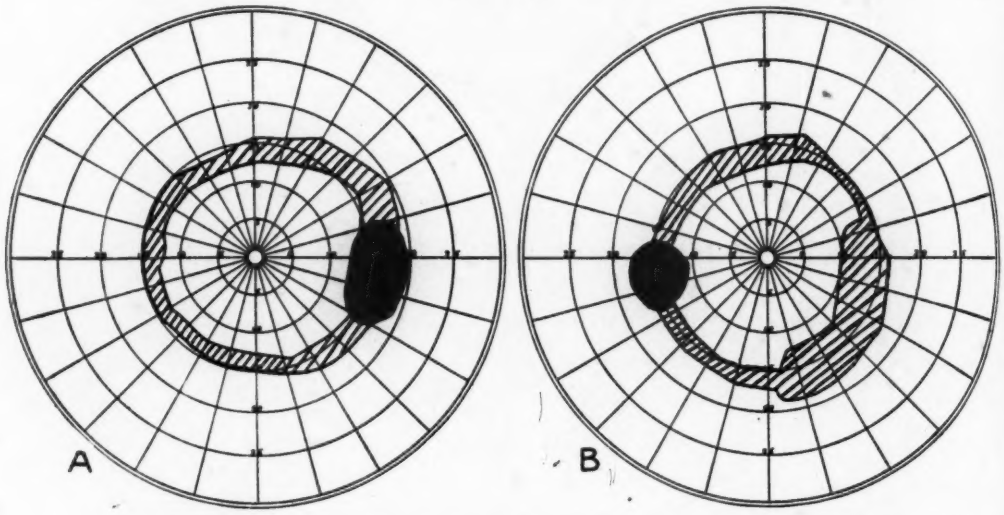

Chart 11 (case 11).—*A*, area of scotoma found in right eye on July 12, 1929. *B*, area of scotoma found in left eye on July 13, 1929.

7 minute test object. On July 13, 1929, relative scotomas were found in both eyes with the Ferree-Rand tangent screen. These are shown in chart 11.

CASE 12.—In a patient, aged 67, the nerve heads showed wide deep physiologic cups, possibly slightly more marked in the right than in the left eye. The anterior chambers were somewhat shallow. Tension was 17 (Schiötz) in both eyes.

Scotometric Observations.—A relative scotoma (chart 12) was found in the right eye with a 7 minute white test object on the Ferree-Rand tangent screen.

CASE 13.—A patient, aged 56, had shallow anterior chambers and small corneas. The tension and nerve heads were normal in both eyes.

Scotometric Observations.—A relative scotoma joining the blind spot was found in the lower visual field of the left eye with a 7 minute test object on the Ferree-Rand screen, and with a 3.5 minute test object on the screen at 1 meter. The smaller test object was substituted in the latter case because no scotoma could be found on the screen at 1 meter when the 7 minute test object was used.

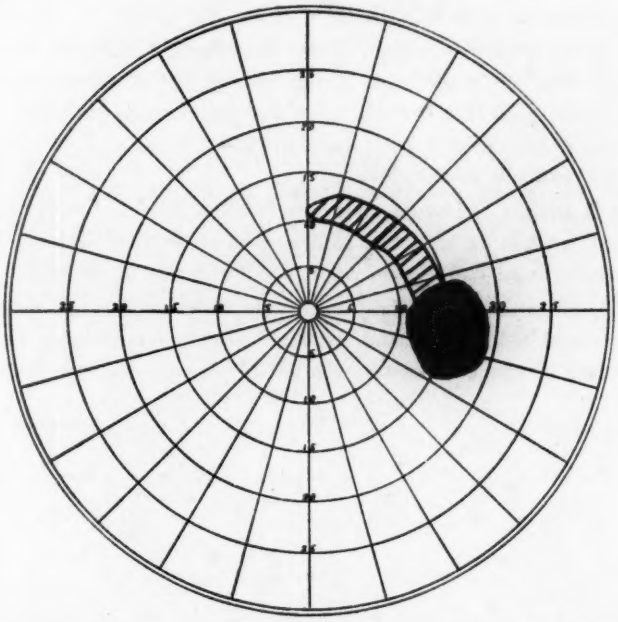

Chart 12 (case 12).—Area of scotoma found in right eye on July 2, 1929.

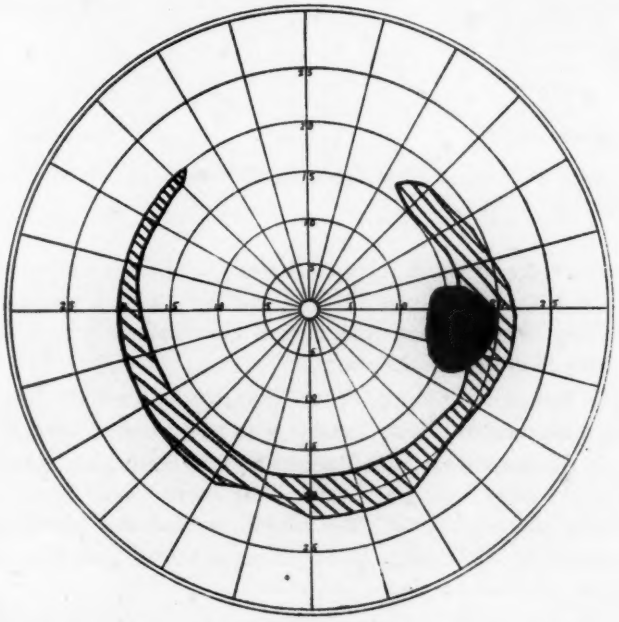

Chart 13 (case 15).—Area of scotoma found in right eye on June 25, 1929.

Case 14.—A patient, aged 50, had absolute glaucoma in the left eye. The nerve head and tension were normal in the right eye.

Scotometric Observations.—Right Eye: On May 29, 1929, an absolute scotoma connected with the blind spot was found on the Ferree-Rand screen with a 7 minute test object. On October 23, when the patient was examined with a test object subtending the same visual angle on the screen at 1 meter, a similarly located relative scotoma was found.

Case 15.—A patient had acute glaucoma in the left eye. In the right eye there were occasional attacks of blurring, pain and haloes around lights. Tension was normal; the nerve head had a good color, and there was no cupping.

Scotometric Observations.—Right Eye: On three occasions a relative scotoma in the lower visual field was found with a 7 minute test object. On March 23, 1929, the tangent screen at 1 meter was used. A scotoma was found extending

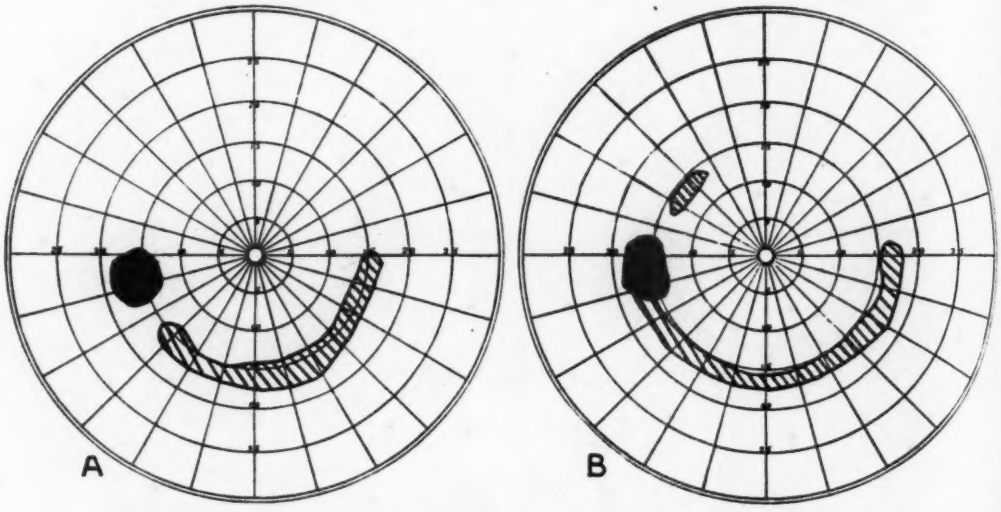

Chart 14 (case 16).—Area of scotoma found in left eye: *A*, on June 7, 1929. and *B*, on June 27, 1929.

from the lower border of the blind spot almost to the horizontal meridian of the nasal field. On May 2, and June 25, 1929, similarly located scotomas somewhat greater in extent, were found on the Ferree-Rand tangent screen. The results obtained on June 25 are shown in chart 13.

Case 16.—A patient showed established glaucoma in the right eye. In the left eye the nerve head was normal. Tension was never higher than 27 (Schiötz).

Scotometric Observations.—Left Eye: On June 7, 1929, a relative scotoma, separated from the blind spot, was found in the lower visual field. Three weeks later the scotoma in the lower field had joined the blind spot and a small isolated scotoma had appeared in the upper field. These scotomas, shown in chart 14, disappeared shortly after pilocarpine was instilled.

Case 17.—A patient had absolute glaucoma in the left eye. In the right eye a wide deep physiologic cup occupied the lower outer part of the disk. The large

vessels did not bend much, but there was a slight suggestion of glaucomatous cupping. No tension higher than 23 (Schiötz) was detected.

Scotometric Observations.—Right Eye: A small relative scotoma, separated from the blind spot, was found on May 31, 1929, and again on October 30 (chart 15).

In this group of cases also, some showed on repeated tests evidence of an advance in the pathologic process, whereas others showed a certain degree of recovery of function. Such remissions in the early stages of the disease are to be expected in view of the variations in tension which are known to occur in glaucoma. In the later stages, the nerve

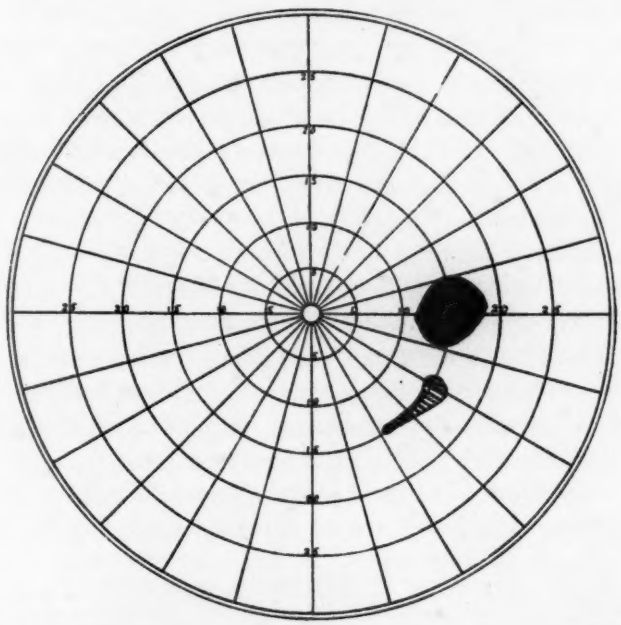

Chart 15 (case 17).—Area of scotoma found in right eye on May 31, 1929.

fibers have presumably become permanently damaged, and a decrease in the pressure on the optic nerve is therefore less likely to bring about restoration of function. That many of these scotomas do not represent permanent loss of function of the nerve fibers is indicated also by the number of instances in which a scotoma was found to disappear shortly after the pupil had been contracted with pilocarpine.

3. SUMMARY OF CASES IN WHICH SCOTOMAS DISAPPEARED OR DECREASED IN SIZE AFTER TREATMENT WITH PILOCARPINE

In the cases described in the two previous sections there were a number of instances in which scotomas were influenced by the use of

pilocarpine.[9] These will be summarized here without repetition of the complete histories.

In case 1 absolute scotomas above and below the blind spot were found to have decreased to approximately one-half their former width immediately after 3 drops of a 2 per cent solution of pilocarpine had been instilled at ten minute intervals. In case 3 an absolute scotoma was found in a patient who had a tension of 35 (Schiötz). Forty-five minutes after 1 drop of a 2 per cent solution of pilocarpine was given, the scotoma shrank to approximately one-fourth its former length. In another patient (case 5), on two occasions, an absolute scotoma was made to disappear completely after the use of pilocarpine. In case 15, relative scotomas in the upper and lower visual fields—the former separated from the blind spot, and the latter continuous with it—were both caused to disappear shortly after pilocarpine had been instilled. In case 9, a relative scotoma disappeared almost completely one hour after 2 drops of a 2 per cent solution of pilocarpine had been used. Two months later, a larger scotoma was found which, however, remained unchanged in size after 3 drops of a 2 per cent solution of pilocarpine had been instilled.

The results in the last case seem to indicate that the immediate disappearance of a scotoma after the use of pilocarpine occurs only in the early stages of its existence. That slightly more advanced scotomas may, however, disappear after prolonged treatment with pilocarpine is shown in the following two instances. In case 4 an absolute scotoma was found on March 8, 1929. Two weeks later the scotoma was found to be reduced to approximately one-fourth its former area. On July 1, a relative scotoma was found, but no absolute scotoma could be detected.

9. The effect of pilocarpine in reducing the areas of the scotomas was not studied consistently throughout this investigation. It was noticed by chance, owing to the fact that the same patients were used in a study of the light sense in early glaucoma. The procedure followed in testing the light sense has been described in several papers by Derby and others (Waite, J. H.; Derby, G. S., and Kirk, E. B.: The Light-Sense in Early Glaucoma, Tr. Ophth. Soc. U. Kingdom **45**:313, 1925. Derby, G. S.; Chandler, P. A., and Sloan, L. L.: A Portable Adaptometer, Tr. Am. Ophth. Soc. **27**:110, 1929). In order that the results might be independent of the pupillary aperture, the pupil was fixed by instilling pilocarpine, its diameter measured, and a correction factor applied to the results of the determinations of the light sense. Patients who were using pilocarpine regularly were requested to discontinue its use for twenty-four hours before presenting themselves for the test, in order that the pupil might be large enough to permit of a satisfactory examination of the fundus. It was thus possible, in a number of instances, to make the search for scotomas under two conditions: when no pilocarpine had been used for at least twenty-four hours, and when sufficient pilocarpine had been instilled to abolish the reaction of the pupil to light. The results of this comparison are summarized in section 3.

CASE 18.—A patient, aged 66, came to the hospital in May, 1928, complaining of tearing. The nerve heads were slightly indicative of early glaucomatous cupping, more so in the right eye than in the left. Tension was a low normal in both eyes. The patient was treated with pilocarpine.

Scotometric Observations.—In December, 1928, when the visual fields were examined with a 10.5 minute white test object on the screen at 1 meter, an absolute Bjerrum scotoma was found in the upper visual field of the right eye. The same scotoma was found in April, 1929, but its limits were much less definite. In June, 1929, no trace of it could be found either on the tangent screen at 1 meter or on the Ferree-Rand tangent screen. In September, 1929, with the latter screen a small relative scotoma was found in the upper visual field.

There are several ways in which the instillation of pilocarpine might affect the visual fields. 1. The small pupillary aperture improves the focus and hence increases the visibility of the test object. The transient myopia produced by the pilocarpine may, however, either reduce or increase the clearness of the image of the test object on the retina. 2. The small pupil reduces the amount of light reaching the retina and consequently reduces the visibility of the test object. 3. Pilocarpine restores the proper functioning of the retina either by means of a reduction of the intra-ocular tension or by the production of some other therapeutic effect. The disappearance of a scotoma after the instillation of pilocarpine might therefore be due either to an increase in the clearness of the image of the test object on the retina or to a true therapeutic effect of the pilocarpine.

The effect of pilocarpine on the size of a scotoma and the probable mechanism of its action have been studied in detail by Samojloff.[10] He described the results of experiments in which variations in intra-ocular tension were produced by several different methods and a study made of the relation between the intra-ocular tension and the extent of the scotoma. An increase in tension was produced in the normal eye by means of injections of a hypertonic salt solution, and a decrease in tension was produced in the glaucomatous eye by the use of pilocarpine and epinephrine and by mechanical pressure. The injection of the salt solution produced an arcuate scotoma in twenty or thirty minutes; the scotoma disappeared entirely in about two hours. The pilocarpine was found to produce a decrease in the area of the scotoma which paralleled the decrease in the tension; the epinephrine decreased the tension, but had no effect on the scotoma; the mechanical pressure produced a decrease

10. Samojloff, A. J.: Études scotométriques de l'oeil hypertendu, Ann. d'ocul. **161**:523, 1924; Einige Bemerkungen zur Frage über die Skotombildung, Ztschr. f. Augenh. **58**:214, 1925; Weitere Untersuchungen über die Skotombildung, Ztschr. f. Augenh. **58**:282, 1925-1926; Experimentelle und klinische Untersuchungen über die Wirkung des Adrenalins auf die Augendruck, Klin. Monatsbl. f. Augenh. **74**:652, 1925.

in tension but an increase in the area of the scotoma. Samojloff suggested that interference with the circulation of lymph through the perivascular spaces plays an important rôle in the production of these transient scotomas. Mechanical pressure, even though it lowers the tension, interferes with the circulation of lymph and thus increases the size of the scotoma. The fact that epinephrine does not affect the area of the scotoma is explained as follows: "Der grosse Unterschied in der Wirkung des Pilokarpins und des Adrenalins auf des glaukomatöse Skotom lässt sich nicht leicht erklären. Es ist möglich, dass das Adrenalin auf den Umfang des glaukomatösen Skotoms deshalb nicht wirkt, weil dieses Präparat durch starke Verengerung der Blutab- und -ausflusswege eine Stase in den Kapillaren bewirken kann (Krogh). Der hohe Blutdruck begünstigt daher die Transsudation der Flüssigkeit aus den Gefässen und kann deshalb, ungeachtet des niedrigen Augendruckes, die Rückbildung des eigenartigen Oedems, durch das ich das glaukomatöse Skotom zu erklären versuchte (Samojloff), verhindern." [11] ("The considerable difference between the action of pilocarpine and of epinephrine on glaucomatous scotoma is not easily explainable. A possible reason why the epinephrine fails to influence the extent of the glaucomatous scotoma is that this preparation causes a stasis in the capillaries by its contraction of the discharging blood channels [Krogh]. High blood pressure promotes the transudation of fluid from the vessels; regardless of the lowered intra-ocular pressure, it can therefore prevent the retrogression of the characteristic edema by which I tried to explain glaucomatous scotoma [Samojloff].") Samojloff also investigated the effect of pilocarpine on scotomas resulting from pathologic conditions other than glaucoma, and found that in these cases the instillation of pilocarpine produced no change in the size of the scotoma. He expressed the belief, therefore, that a scotoma of the Bjerrum type which disappears or decreases in size shortly after the instillation of pilocarpine may be considered a definite symptom of glaucoma.

Others have shown that the regular use of pilocarpine for longer periods of time, weeks or months for example, frequently results in the disappearance of the scotomas characteristic of early glaucoma. Seidel,[12] in 1914, showed that the appearance and disappearance of the small winglike extensions of the blind spot which are characteristic of the early stages of the disease are closely related to the changes in tension. More recently, Evans [13] published similar data showing that the arcuate

11. Samojloff (footnote 10, fourth reference, p. 670).

12. Seidel, E.: Beiträge zur Frühdiagnose des Glaukoms, Arch. f. Ophth. **88**: 102, 1914.

13. Evans, J. N.: Interpretation of Defects in the Visual Field, Arch. Ophth. **3**:153 (Feb.) 1930.

"vessel scotomas" extending from the blind spot increase and decrease in size in accordance with the length of time that pilocarpine had been used or discontinued. It was his opinion that the careful mapping of such scotomas gives a more delicate indication of the state of the intraocular tension than can be obtained with the tonometer. His explanation of the production of these transient scotomas is somewhat similar to that proposed by Samojloff.

A test of the effect of pilocarpine on the extent of the scotoma, as suggested by Samojloff, should prove a valuable supplement to perimetry in the diagnosis of glaucoma. In this paper it has been shown that an arcuate scotoma, connected with the upper or lower border of the blind spot or located where its extension would be so connected, may occur when other definite symptoms of glaucoma are lacking. Since confirmatory symptoms of glaucoma may therefore be absent or doubtful in a given case, the question arises as to whether or not a diagnosis can be made from the scotometric observations alone; i. e., whether or not a scotoma of the Bjerrum type can be considered as exclusively a symptom of glaucoma. In 1913, for example, von Szily [14] described a case in which a typical Bjerrum scotoma was found in conjunction with a choked disk. Löhlein [15] stated that changes in the visual field similar to those which Bjerrum and Rönne found in glaucomatous eyes may also occur in various diseases of the optic nerve and in cases of closure of a branch of the retinal arteries. He published a report of the visual fields in three cases of this kind. Rönne [16] found that in 119 cases of atrophy of the optic nerve and optic neuritis, only four showed changes in the visual fields similar to those considered typical of glaucoma. It should be pointed out that the visual fields presented by these and other investigators correspond to those occurring in fairly well advanced cases of glaucoma; consequently, even if a positive diagnosis cannot be made, the fact that the tension and the nerve head are normal serves to eliminate the possibility of glaucoma. The question as to whether or not very early changes in the fields, such as those described in this investigation, may occur without additional diagnostic symptoms in other pathologic conditions or even in normal eyes has, however, received little attention in the literature. Lloyd [17] stated: "this form of defect

14. von Szily, A.: Von dem blinden Fleck ausgehendes Ringskotom (sogenannten Bjerrumsches Zeichen) bei zerebral Stauungspapille, Klin. Monatsbl. f. Augenh. **51**:196, 1913.

15. Löhlein, W.: Examination of the Visual Field in Glaucoma and Its Value for Differential Diagnosis, Arch. Ophth. **45**:51 (Jan.) 1916.

16. Rönne, H.: Ueber das Gesichtsfeld beim Glaukom, Klin. Monatsbl. f. Augenh. **47**:12, 1919.

17. Lloyd, R. I.: Visual Field Studies, New York, Technical Press, 1926, p. 41.

is not an exclusive glaucoma sign but is often found in the senile eye or the angiosclerotic." No reference was made, however, to experimental data in support of this statement. If it is true that the scotomas characteristic of incipient glaucoma may occur also in eyes without glaucoma, a test of the effectiveness of pilocarpine in reducing the area of the scotoma, as advocated by Samojloff, should prove a valuable aid in diagnosis.

CONCLUSIONS

The scotomas associated with the incipient stages of glaucoma are shown to be of such a nature that they are easily overlooked or ignored. Because they may occur as relative scotomas only and because they may be isolated from the blind spot, they are not always easily detected. When they are found, moreover, often but little importance is attributed to them. This may be due in part to the fact that they are frequently of a rather transient nature, and their presence cannot always be verified when a second test is made at a later date. It is probably largely due, however, to the fact that they may occur when no confirmatory symptoms are present to support the diagnosis of incipient glaucoma. In such cases a test of the effectiveness of pilocarpine in reducing the area of the scotoma, as advocated by Samojloff, is suggested as a means of obtaining supplementary evidence. The value of an early diagnosis in the successful treatment for glaucoma is generally recognized. It should be emphasized also that the possibility that early diagnosis offers for studying the disease in its incipient stages is an important adjunct to the investigation of its underlying causes. The characteristics of the scotomas found to occur in incipient glaucoma and the changes produced in these scotomas when pilocarpine is instilled into the eye have been reported with the hope that this information may aid in the early diagnosis of glaucoma.

BIOCHEMICAL INVESTIGATION OF THE NITROGEN, WEIGHT AND WATER CONTENT OF CRYSTALLINE LENSES *

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Fifty or more years ago, Laptschinsky [1] and Cahn [2] analyzed both normal cattle lenses and cataractous human lenses for various chemical constituents. Among other observations they published comparative data on the protein content of the two kinds of lenses. According to Laptschinsky, the average figure for normal cattle lenses is 34.93 per cent, evidently computed on the basis of the fresh lens. Cahn, in reviewing the work of Laptschinsky and in discussing his own observations, stated that the normal cattle lens consists of about 94.71 per cent of protein, whereas cataractous human lenses show a protein content only of from 81.48 to 85.37 per cent, evidently computed on the basis of the dry lens substance. More recently, Jess [3] stated that the cataractous lens is deficient chiefly in the crystallins, alpha and beta, as compared with the normal lens, and that the ratio of crystallins to albumins in young persons is 82:18, whereas in old persons the ratio is 41:50. Moreover, Bürger and Schlomka,[4] who carried out similar experiments on cattle lenses over a range of average ages from 3 days to 15 years, showed that the nitrogen content, on the basis of the fresh lens, increases from 4.88 to 5.89 per cent, or, as computed on the basis of the dry lens, it increases from 15.5 to 16.5 per cent up to the beginning of the second decade, then decreases to 16.1 per cent. Simultaneously, according to the same authors, the water content decreases continually from 68.4 to 63.4 per cent, whereas the weight of the lens increases from 1.06 to 2.36 Gm. According to Jess,[5] the solids of the human lens increase from 29.2 in the third year to 35.4 per cent in the sixty-third year.

So far, however, no one seems to have determined the nonprotein nitrogen, and therefore it is not known how much of the total nitrogen is represented by protein nitrogen. In view of this fact, one is justified

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1. Laptschinsky: Arch. f. d. ges. Physiol. **13**:631, 1876.
2. Cahn: Hoppe-Seylers Ztschr. f. physiol. Chem. **5**:213, 1881.
3. Jess: Ztschr. f. Biol. **61**:93, 1913.
4. Bürger, M., and Schlomka, G.: Ztschr. f. d. ges. exper. Med. **58**:710, 1927.
5. Jess: Arch. f. Ophth. **105**:428, 1921.

in asking whether or not the decrease in protein content of cataractous lenses reported by Laptschinsky and Cahn may be attributed merely to a process of aging or to some pathologic condition. In order to throw some light on this particular phase, the work of Bürger and Schlomka was repeated on the protein nitrogen of cattle lenses varying in age from 2 months to 2 years; at the same time the amount of nonprotein nitrogen was also determined. In addition, seventeen cataractous human lenses were examined for the total amount of nitrogen.

METHOD OF ANALYSIS

A micro-Kjeldahl [6] method was employed in all of the analyses, a single lens being used in each determination. The lens in which both the nonprotein and the protein nitrogen were to be determined was rubbed to a more or less fine powder in a small mortar with enough solid trichloracetic acid to give, on dilution, a 10 to 15 per cent solution. The residue was repeatedly extracted by maceration in fresh portions of the trichloracetic acid solution, each extract being filtered through a small filter paper into a flask. Finally all of the precipitated, powdery, lens protein was brought quantitatively on this filter paper and repeatedly washed with a dilute trichloracetic acid solution. The nitrogen content of the filtrate was assumed to represent the nonprotein nitrogen of the lens, whereas the protein nitrogen values were obtained from the analysis of the protein residue on the filter paper.

The protein values of the animal lenses were computed by multiplying the figure for protein nitrogen by the factor 6.25.

A single human lens, on account of its small size, does not contain enough nonprotein nitrogen for a quantitative estimation within the generally accepted limits of experimental error. Hence in all cases only the total amount of nitrogen was determined. But, since the nonprotein nitrogen, judging by analogy from results obtained on animal lenses, is a negligible amount, approximate figures for protein were obtained by multiplying the figure of their total nitrogen by the usual factor 6.25.

In every series of analyses a blank was run on the reagents and other material included in the samples, such as filter paper, trichloracetic acid solution and the amount of distilled water that was usually employed.

ANALYSES OF ANIMAL MATERIAL

Determinations of Nitrogen.—In table 1 are given the values for the nonprotein nitrogen of cattle lenses varying in age from 2 months to 2 years. They are nearly the same for all the ages represented within the foregoing narrow limits. There is, however, a distinct increase in the protein in nitrogen of the lens within this range as the animals grow older. This is in agreement with the observations of Bürger and Schlomka. The results are presented in table 1, are summarized in table 5 and are plotted in chart 1.

6. Myers: Practical Chemical Analysis of Blood, St. Louis, C. V. Mosby Company, 1924.

TABLE 1.—*Determinations of Nonprotein Nitrogen of Lenses of Cattle Varying in Age from 2 Months to 3 Years*

Animal	Age of Animal	Number of Eye	Weight of Fresh Lens, Gm.	Nonprotein Nitrogen, Mg. per 100 Gm.
1	2 months	1	1.2500	100.0
		2	1.1760	125.0
2	3 months	1	1.2610	100.0
		2	1.3305	116.5
3	8 months	1	1.4060	102.0
		2	1.2960	70.2
4	1 year	1	1.8142	100.3
		2	1.6815	108.2
5	1 year	1	1.8172	83.2
		2	1.7255	.....
6	1 year	1	1.7653	75.3
		2	1.7947	101.4
7	1 year	1	1.6848	99.7
		2	1.6357	68.5
8	2 years	1	2.1095	.....
9	2 years	1	2.2500	.....
		2	2.2111	.....
Sheep	Adult	1	0.8400	115.5

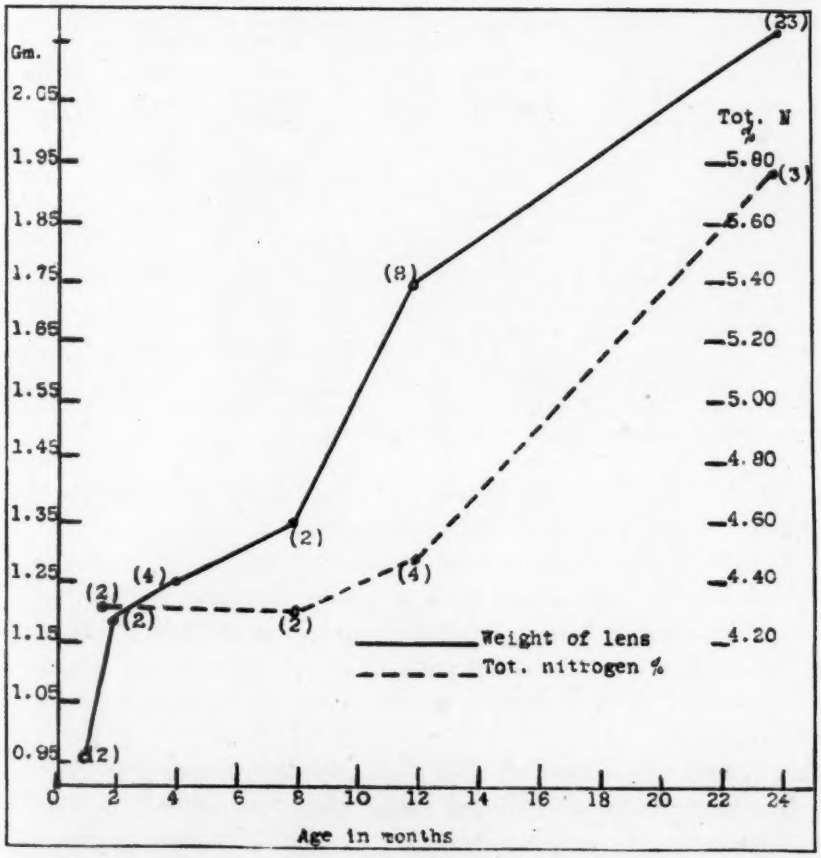

Chart 1.—Rate of increase in weight and total nitrogen of ox lens with advancing age. The figures in parentheses denote the number of lenses on which the averages were based.

The figures for total nitrogen (table 2), except those marked with an asterisk, were obtained by adding the figure for the nonprotein nitrogen to that of the protein nitrogen. Values for total nitrogen marked with an asterisk were obtained on samples that included both the nonprotein and the protein nitrogen; that is, no analysis was made for nonprotein nitrogen on these samples. Data obtained on other lenses show that the nonprotein nitrogen is nearly the same for the different age groups of the same types of animals and that its average amount is about 100 mg. per hundred grams of lens. Hence the values for protein in the three cases marked with an asterisk were obtained by sub-

TABLE 2.—*Determinations of Protein Nitrogen of Lenses of Cattle Varying in Age from 2 Months to 2 Years*

Animal*	Age of Animal	Number of Eye	Protein Nitrogen, per Cent	Total Nitrogen, per Cent	Protein, per Cent
1	2 months	1	4.170	4.270	26.06
		2	4.107	4.232	25.67
2	3 months	1	4.663	4.763	29.14
3	8 months	1	4.281	4.383	26.76
		2	4.051	4.121	25.32
4	1 year	1	5.016	5.116	31.35
		2	4.810	4.918	30.06
5	1 year	2	4.710	.....	29.44
6	1 year	2	4.600	4.701	28.75
7	1 year	2	4.922	4.990	32.24
8	2 years	1	.....	5.673*	34.73*
9	2 years	1	.....	5.848*	35.93*
		2	.....	5.836*	36.48*
Sheep	Adult	1	3.833	3.948	23.96

* See table 1 for weights of the corresponding lenses.

tracting 0.1 Gm. from the figure representing the percentage of total nitrogen and multiplying by the usual factor 6.25.

In table 3 are presented the values for the nonprotein nitrogen of rabbit lenses. The rabbits were of nearly the same age and weight, so that the figures have no significance as far as age is concerned, but, when they are compared with those of cattle lenses (table 1), they are found to be somewhat lower. A whole lens was used in each determination.

In table 4 the values are given for the protein nitrogen, the total nitrogen and the protein of the same lenses on which the data for the nonprotein nitrogen were obtained. The figures for the total nitrogen and the protein were obtained in the same manner as described for cattle lenses, in connection with the data presented in table 2.

In table 5 a summary is given of the average values for the weight and the nitrogenous constituents determined on fresh lenses of animals of different species and ages. The data bring out, at least for the bovine species, that the lens increases not only in weight, but also in the total

TABLE 3.—*Nonprotein Nitrogen of Rabbit Lenses*

Animal	Weight of Animal	Number of Eye	Weight of Fresh Lens, Gm.	Nonprotein Nitrogen, Mg. per 100 Gm.
1	4 pounds	1	0.5009	118.7
		2	0.4860	86.4
2	4½ pounds	1	0.4578	76.5
		2	0.4586	92.5
3	5 pounds	1	0.5290	66.1
		2	0.5217	93.9
4	5½ pounds	1	0.4938	85.0
		2	0.4979	84.0
5	5½ pounds	1	0.4323	81.0
		2	0.4330	76.0
6	?	1	0.3370	104.0
		2	0.3525	80.0
7	?	1	0.3315	35.0
		2	0.3170	36.4
8	?	1	0.5748	70.0
		2	0.5180	119.0

TABLE 4.—*Protein Nitrogen of Rabbit Lenses*

Animal*	Weight of Animal	Number of Eye	Protein Nitrogen, per Cent	Total Nitrogen, per Cent	Protein, per Cent
1	4 pounds	1	6.916	7.035	43.23
		2	4.825	4.911	30.16
2	4½ pounds	1	5.963	6.040	37.27
		2	5.941	6.034	37.13
3	5 pounds	1	5.293	5.359	33.08
		2	5.568	5.662	34.80
4	5½ pounds	2	6.045	6.129	37.78
5	5½ pounds	1	4.372	4.453	27.33
		2	5.496	5.572	34.35
6	?	2	4.884	4.964	30.53
7	?	1	4.042	4.077	25.26
		2	3.733	3.769	23.33
8	?	1	4.697	4.767	29.36
		2	5.675	5.789	35.47

* See table 3 for weights of the corresponding lenses.

amount of nitrogen and protein. One should bear in mind, however, that the ages are only approximations.

Determinations of Weight and Water Content.—The results of these determinations are presented in the following tables and are shown graphically in charts 1 and 2.

In table 7 are given the average values of the water content and the solids of cattle lenses for different age groups.

TABLE 5.—*Average Values of the Weight and the Nitrogenous Constituents of Fresh Lenses of Various Animals*

Animal	Age	Weight of Fresh Lens, Gm.	Total Nitrogen, per Cent	Nonprotein Nitrogen		Protein, per Cent
				Mg. per Cent	Range, per Cent	
Calf.....	5 weeks	0.9846 (2)*	....	.....	.....	.....
Calf.....	2 months	1.2175 (2)	4.14 (2)	112.5 (2)	100-125	25.86 (2)
Calf.....	3 months	1.2957 (2)	4.66 (1)	108.2 (2)	100-116.5	29.14 (1)
Calf.....	4 months	1.2047 (2)	....	.....	.....	.....
Calf.....	8 months	1.3510 (2)	4.25 (2)	86.1 (2)	70-102	26.04 (2)
Calf.....	1 year	1.7650 (14)	4.50 (4)	91.0 (7)	68-108	30.37 (5)
Cow.....	1½ years	2.0031 (17)	....	.....	.....	.....
Cow.....	2 years	1.9179 (36)	5.79 (3)	.....	.....	35.71 (3)
Sheep.....	?	0.840 (1)	3.948 (1)	115.5 (1)	.....	23.96 (1)
Rabbit.....	Adult (5 pounds)	0.4646 (20)	5.43 (14)	81.0 (16)	85-119	33.40 (14)

* The figures in parentheses denote the number of lenses on which the averages (above them) were based.

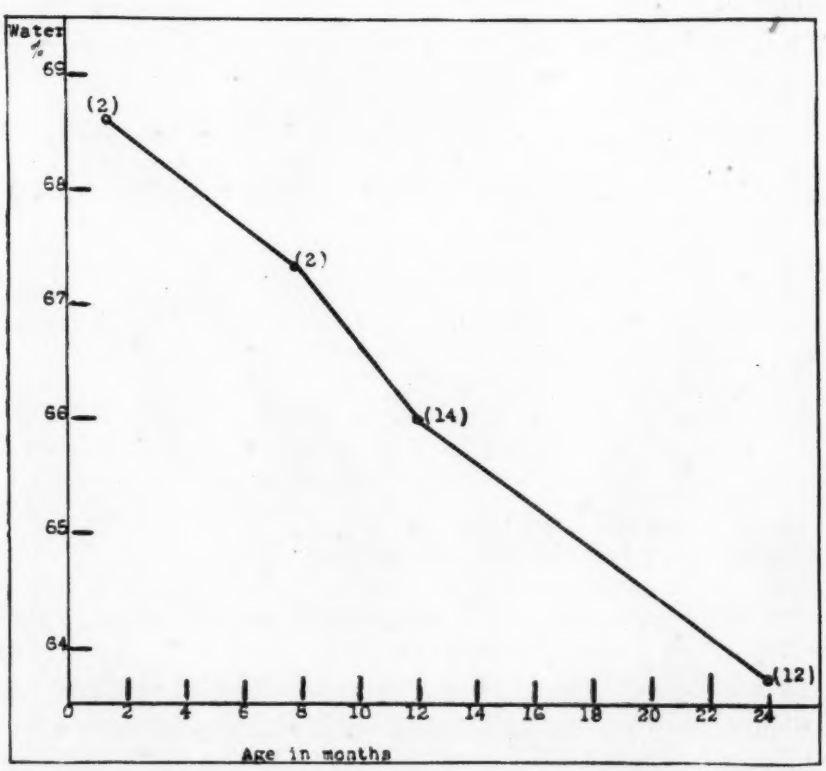

Chart 2.—Rate of decrease in water content of ox lens with advancing age. The figures in parentheses denote the number of animals on which the averages were based.

TABLE 6.—*Weight and Water Content of Normal Lenses of Cattle Varying in Age from 5 Weeks to 2 Years*

Animal	Age of Animal	Number of Eye	Weight of Fresh Lens, Gm.	Weight of Dry Lens, Gm.	Percentage of Water	Percentage of Dry Substance
1	5 weeks	1	0.9822	0.3073	68.71	31.29
		2	0.9871	0.3103	68.56	31.44
2	4 months	1	1.2035	0.4890	67.96	32.66
		2	1.2058	0.4880	67.34	32.84
3-6	1 year	..	1.7870	0.6465	63.82	36.18
	1 year	..	1.8270	0.6080	66.72	33.28
	1 year	..	1.8175	0.6005	66.96	33.04
	1 year	..	1.7970	0.6150	65.77	34.23
	1 year	..	1.8120	0.6220	65.67	34.33
	1 year	..	1.8230	0.5880	67.74	32.26
7	1 year	1	1.8142	0.6361	64.94	35.06
		2	1.6815	0.5867	65.10	34.90
8	1 year	1	1.8172	0.6015	66.90	33.10
		2	1.7255	0.5835	66.19	33.81
9	1 year	1	1.7653	0.6300	64.30	35.70
		2	1.7947	0.5521	69.23	30.77
10	1 year	1	1.6848	0.5888	65.08	34.92
		2	1.6357	0.5645	65.49	34.51
11	1½ years	1	2.0302	0.7137	64.85	35.15
		2	2.1584	0.7181	66.73	33.27
12	1½ years	1	1.7445	0.5807	66.71	33.29
		2	1.6627	0.5723	65.58	34.42
13	1½ years	1	1.9036	0.7005	65.50	34.50
		2	2.0058	0.7093	64.64	35.36
14	1½ years	1	2.3081	0.7729	66.51	33.49
		2	2.1734	0.7644	64.83	35.17
15	1½ years	1	2.0106	0.6878	65.79	34.21
		2	2.0818	0.6888	66.91	33.09
16	2 years	1	2.1592	0.8086	62.55	37.45
		2	2.0663	0.8057	61.01	38.99
17	2 years	1	2.4892	0.8697	65.06	34.94
		2	2.4349	0.8628	64.57	35.43
18	2 years	1	1.9927	0.6498	56.70	43.30
19	2 years	1	2.3089	0.8105	64.90	35.10
		2	2.3068	0.8107	64.86	35.14
20	2 years	1	1.7634	0.7166	59.36	40.64
21	2 years	1	2.2470	0.8065	64.11	35.89
		2	2.1100	0.7070	66.49	33.51
22	2 years	1	2.2500	0.8495	62.25	37.75
		2	2.1851	0.7212	67.00	33.00
23	2 years	1	2.0733	0.7158	65.48	34.52
		2	2.0637	0.7026	65.95	34.05
24	2 years	1	2.1475	0.7333	65.83	34.17
		2	2.1463	0.7187	66.52	33.48
25	2 years	1	2.1313	0.7299	65.75	34.25
		2	2.1310	0.7132	66.53	33.47
26	2 years	1	2.1680	0.7513	65.33	34.65
		2	2.2303	0.7491	66.41	33.59
27	2 years	1	1.9579	0.6662	65.97	34.03
		2	1.8773	0.6627	64.70	35.30
28	2 years	1	1.8172	0.5940	67.32	32.68
		2	1.6445	0.5806	64.70	35.30
29	2 years	1	1.8588	0.6127	67.04	32.96
		2	1.8187	0.6208	65.87	34.13
30	2 years	1	2.1976	0.7716	64.89	35.11
		2	2.1036	0.7600	63.87	36.13
31	2 years	1	1.7343	0.6200	64.25	35.75
		2	1.7930	0.6276	65.00	35.00
32	2 years	1	1.6670	0.5901	64.60	35.40
		2	1.7753	0.6029	66.04	33.96
33	2 years	1	1.8032	0.6180	65.73	34.27

Table 8 gives the results obtained on adult rabbit lenses as regards their weight, water content and solids. Since the animals were approximately of the same age, the figures give no information on the rate of dehydration of the lens protein with increase in age. They show, however, that the rabbit lens is much more dense than the cattle lens, the water content being much smaller, and consequently the percentage of solids higher.

DETERMINATIONS OF NITROGEN ON CATARACTOUS HUMAN LENSES

The results of the analyses of seventeen lenses are given in table 9, together with short case histories of the patients. Since no analyses were made for the nonprotein nitrogen on account of the minute amounts

TABLE 7.—*Average Values of the Water Content and the Solids of Cattle Lenses*

Age	5 weeks	4 months	1 year	1½ years	2 years
Percentage of water	68.63	67.25	65.99	65.81	64.61
Percentage of solids	31.37	32.75	34.01	34.19	35.39
Number of animals	2	2	14	10	25

TABLE 8.—*Results on Adult Rabbit Lenses*

Rabbit	Number of Eye	Weight of Fresh Lens, Gm.	Weight of Dry Lens, Gm.	Percentage of Water	Percentage of Dry Substance
1	1	0.4735	0.1950	58.81	41.19
	2	0.5035	0.2030	59.68	40.32
2	1	0.5698	.....	.....	.....
	2	0.5776	.....	.....	.....

of this constituent in a single human lens, approximate values for protein were obtained by multiplying the figure for the total nitrogen by the factor 6.25.

In table 10 the values for nitrogen of the cataractous lenses are arranged in the order of the age of the patient, with the approximate duration of the cataractous condition for both eyes.

The figures for nitrogen seem to be somewhat indicative of the duration of the cataractous condition. Compare the duration and percentage of nitrogen in cases 17*, 14*, 9* and 11*, on the one hand, with those in cases 7^+, 10^+ and 6^+, on the other.

The values for nitrogen appear to be inversely proportional to the duration of the cataractous condition. This is the more striking as the figures for duration are certainly only rough approximations, and no correlation was made between each lens and its specific history. (Such a correlation was attempted, but could not be carried out under the

TABLE 9.—*Results of Analyses of Seventeen Lenses*

Sex, Age, Vision, History	Weight of Lens, Mg.	Total Nitrogen		Approximate Amount of Protein	
		Mg. per Lens	Per Cent	Mg. per Lens	Per Cent
1. Case history unknown	215	6.84	3.18	42.8	19.87
2. Female; aged 74; vision in right eye failing for two or three years, vision in left eye shortly afterward; vision in both eyes, light and shadow	107	3.54	3.32	22.1	20.75
3. Case history unknown	114	4.33	3.09	27.1	19.31
4. Case history unknown	130	7.38	5.68	46.2	35.50
5. Female; aged 71; vision in right eye limited to light and shadow; left eye, counting fingers at 2 feet; left eye failing for several years; right eye, three years later; trachoma in both eyes	168	7.58	4.51	47.4	28.19
6. Male; aged 79; vision in right eye, 6/20 + 1; that in left eye, 6/20; vision failing for ten years; diplopia; one tooth extracted	160	5.86	3.66	36.63	22.88
7. Male; aged 69; vision in right eye, 6/15 — 2; that in left eye, counting fingers at 2 feet; right eye failing for three years; left eye, from ten to fifteen years; pyorrhea; teeth extracted	153	3.92	2.56	24.50	16.00
8. Male; aged 67; right eye failing for three years; left eye for four years; marked atrophy of iris in both eyes	110	4.68	4.25	29.30	26.54
9. Male; aged 79; vision failing for two and one-half years; got around by himself; six teeth with apical abscesses extracted	180	9.76	5.42	61.00	33.87
10. Male; aged 54; vision failing for ten years following blistering of face by burn; two bad teeth	109	3.27	2.86	19.49	17.88
11. Female; aged 60; vision in right eye limited to light and shadow; that in left eye, 6/60; slight pain in right eye two years following swelling of eyelids; one brother had cataract extracted at age of 23; Wassermann reaction, 4+	120	5.24	4.37	32.77	27.31
12. Male; aged 69; vision in right eye limited to light and shadow; that in left eye, 5/60; vision failing for eighteen months	126	2.90	2.30	18.12	14.38
13. Male; vision in right eye, 6/30	107	2.26	2.11	14.11	13.19
14. Female; aged 59; left eye failing for two years, right eye later; read with difficulty; dental caries; pyorrhea	125	7.19	5.67	44.30	35.44
15. Male; aged 74; vision in right eye, 2/60; that in left eye limited to light and shadow; poor vision for thirty-five years; granulated eyelids	162	7.31	4.51	45.67	28.19
16. Case history unknown	145	5.22	3.60	32.63	22.50
17. Female; aged 72; vision in right eye limited to counting fingers at 1½ meters; that in left eye, limited to light and shadow; right eye failing for six weeks, left eye for one year	114	6.62	5.86	41.76	36.63

circumstances.) Thus it is not known whether the lens that was analyzed came from the right or the left eye.

No figures for nitrogen were obtained on normal human lenses. The highest percentages for nitrogen for cataractous lenses with relatively short durations of the cataractous condition are 5.86, 5.68, 5.67 and 5.42. These figures agree closely with those obtained on the lenses of 2 year old cattle and adult rabbits. On the basis of these facts and the figures for the protein content of normal human lenses, which, according to Jess,[3] are 32 per cent (5.12 per cent of nitrogen) in youth, and 38 per cent (6.08 per cent of nitrogen) in old age, it is clear that in its nitrogen content the normal human lens closely resembles that of the adult rabbit and that of older cattle.

TABLE 10.—*Nitrogen Values of the Cataractous Lenses*

Series Number*	Age	Approximate Duration of Cataract, Years	Total Nitrogen, per Cent
10*	51	10	2.86
14*	59	2	5.67
11*	60	2	4.37
8	67	3, 4	4.25
12	69	1½	2.30
7*	69	3, 15	2.56
5	71	3, several	4.51
17*	72	6 weeks, 1 year	5.86
2	74	2, 3	3.32
15	74	2	4.51
9*	79	2½, 3	5.42
6*	79	10	3.66
1	?	?	3.14
13	Private	?	2.11
16	?	?	3.60
4	?	?	5.68
3	?	?	3.00

* See table 9.

If the cases of cataract in which the ages were known, studied in connection with the nitrogen content of the cataractous lenses, are arranged in decades, the following distribution appears: 50-60 years, two; 60-70 years, four; 70-80 years, six.

COMMENT

The tissues of young animals contain more water and less solid matter than those of older animals. The lens of the eye is no exception to this general observation. Determinations of the water content of lenses from cattle varying in age from 5 weeks to 2 years showed a uniform and a rather rapid decrease in this constituent. This is in conformity with the observations of Bürger and Schlomka.[4] It has been suggested, therefore, that this process of natural dehydration of the lens with advancing age, enhanced by some pathologic condition or inherited

traits, may be responsible, at least in part, for the formation of cataract. This dehydration naturally involves an increase in the total solids, most of which are proteins. Similar analyses of senile human lenses with cataract, however, show a decrease in protein content. So far there are no experimental data available that could reconcile the two diametrically opposed conditions.

SUMMARY

1. The lens increases in weight on an average from 0.9846 Gm. in calves of 5 weeks to 1.960 Gm. in cattle of from 1½ to 2 years.

2. The total nitrogen of the lens increases on an average from 4.14 in calves of 2 months to 5.79 per cent in cattle of 2 years. The non-protein nitrogen of cattle lenses, which is nearly the same for all ages within the foregoing narrow limits, averages up to 100 mg. per hundred grams. It was found to be lower in adult rabbits by about 20 mg. per hundred grams. The protein content of the lens (parallel with total nitrogen) increases on the average from 25.86 in calves of 2 months to 35.71 per cent in cattle of two years. Adult rabbit lenses contain on the average 33.4 per cent. The lens of an adult sheep gave the value of 23.96 per cent.

3. The water content of cattle lenses decreases on an average from 68.6 per cent in calves of 5 weeks to 64.6 per cent in animals of 2 years. The analysis of the two lenses of an adult rabbit for this content gave an average of 59.2 per cent.

A NEW OPERATIVE PROCEDURE IN GLAUCOMA*

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The present knowledge concerning the pathology and etiology of glaucoma simplex is still so uncertain that one's attack must remain as yet directed against its most prominent symptom, namely, the increased intra-ocular tension. Fortunately, when one is successful in reducing the increased tension, most of the cases show a marked and more or less permanent relief.

The condition that brought about the increased tension may continue and cause changes in the lens, uveal tract, optic nerve and retina and ultimately result in blindness in spite of reduction of the tension. Regardless of these failures the immediate danger is the increased intra-ocular tension, and present therapy concerns the best and safest means of its reduction and control.

It is my practice to resort to operation if the continued and reasonable use of miotics fails to keep the tension within normal limits and the visual fields in check.

The usual question of whether an iridectomy or a trephine is the operation of choice led me to review my own results to ascertain which method was giving the most satisfactory and permanent relief in my hands.

In this review of my operations I was surprised to find that a great percentage of my successful cases showed fragments of iris tissue in the cicatrix. This incarceration of the iris was also found in cases of so-called cystoid scar, which, incidentally, give satisfactory and lasting results.

These observations led me to the supposition that the success of these operations was due to the iris tissue present in the healed scar.

Following this logic I purposely incarcerated strips of iris tissue in the next two iridectomy cases, and I was elated at my final results. In both cases there developed small discrete blebs like those seen in a successful trephining; a casual observer would have taken them for an excellent result of trephining.

Since this time I have varied my technic from time to time, merely to improve and to attempt to standardize the procedure.

PROCEDURE

A conjunctival flap is made above, but not dissected free down to, the limbus. The incision into the anterior chamber is usually made with a keratome, but if the

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* Read before the Pacific Coast Oto-Ophthalmological Association, Victoria, B. C., Sept. 3, 1930.

chamber is shallow a Graefe knife is used, the incision being about 6 mm. in length. A moderate-sized iridectomy is then performed with a de Wecker scissors and the section of tissue of the iris removed is floated out on physiologic solution of sodium chloride.

A small section of tissue of the iris is picked up on a repositor; it is inserted into the anterior chamber and by a sweeping motion, is placed in the sharp angle of the incision, where it is firmly gripped as the edges of the wound come together. The conjunctival flap is smoothed into place, and the eye is dressed. The fragment of iris is firmly held in the angle of the incision. I have never experienced any difficulty in its becoming dislodged.

The lowering of the tension by the foregoing procedure is due to the iris tissue embedded in the cicatrix, and in successful cases it produces a fistulating opening lined with pigment epithelium. This tract brings the anterior chamber into communication with the subconjunctival and episcleral tissue, thus establishing a permanent drainage fistula.

When I presented this subject at the local medical society, I was particularly interested to learn that I had independently arrived at the same conclusions as Holth with whose work I was not acquainted previously. Holth had a rare opportunity to study microscopically eyes that had been operated on by iris inclusion methods. His interesting observations were:

The bulbar conjunctiva shows normal and unimpaired epithelium in the cushion-like portion covering the field of operation. The conjunctival connective tissue is seen to have fibers somewhat closer together and richer in cells than normally, especially toward the episclera where the conjunctiva was loosened by the operation. No cells show any degenerative changes. In the intercellular connective tissue of the conjunctiva there are areas of diffuse hyalin degeneration. All show a complete fistula lined with pigment epithelium. . . . The conjunctiva is somewhat raised into a soft cushion surrounded by edema which is increased by massage. The iris inclusion forms a funnel shaped space the walls of which are lined with pigment epithelium and extends back into episcleral tissue. They end without any reactive process.

I believe that my procedure is superior to iridotasis and iridenclesis, in that the incarcerated tissue of the iris and the iris are not connected. The pupil retains its original position as in the old type of iridectomy and is not drawn upward or subjected to constant traction as it has been in most other cases that I have observed.

H. Herbert has reported an inclusion operation which is much like the one that I have described. His method of subconjunctival approach is ingenious. I have tried to adapt this to my procedure, but have not had the opportunity to perfect it.

While my procedure is not thoroughly worked out to my own satisfaction, I believe that it has promising possibilities in the operative field of glaucoma.

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Clinical Notes

A TEST FOR RETINAL FUNCTION IN CATARACTOUS PATIENTS*

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It is often the source of much chagrin to both patient and operator when, following the removal of a cataract from an eye which had apparently projected light perfectly, a great defect is discovered in the macular region. The patient has had his hope of useful vision abruptly shattered, and the operator feels cheated out of the rewards of a trying and hazardous venture. Unfortunately, a history of previous visual acuity from the patient is not always reliable, and the projection test as ordinarily practiced does not reveal central retinal changes. The means of producing a very feeble illumination for testing macular perception are not always available.

While experimenting with entoptic phenomena, it occurred to me that the subjective visualization of one's own retina might be employed in detecting central lesions or central amblyopia. The method is well known. One removes the head from the electric ophthalmoscope and places the light, covered by the condensing lens of the instrument, against the closed eye. Pressure is made against the sclera, and the light gently moved to and fro. The vascular tree will appear as a black tracery against the reddish background. The macular area is clearly defined as a dull red, avascular oval. The patient is told to look for a pattern similar to the "veins in a leaf." With this simple simile even unintelligent patients are surprisingly quick to recognize the vessels. The "good" eye, in unilateral cases, is examined first as a control, and the patient is told to pay particular attention to the vessel-free area. He is then asked to compare it to the corresponding region in the cataractous eye. The response is more difficult to elicit and less reliable when there is no obviously healthy eye to serve as a control.

A patch of central chorioretinitis will be seen as a spot where the patient "sees nothing" in the red field, and the surgeon is thus forewarned. An amblyopic eye in which a cataract has developed, unless it has a squint to draw suspicion, might easily become another pitfall, but in such a case the patient will "see" his macula as a black or dark brown spot, and will again forewarn the operator.

Retinal detachments may be readily detected by subjective visualization, and most likely this method will prove of value in instances of retinal detachment in which the projection of light is not faulty.

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* From the Herman Knapp Memorial Eye Hospital.

Like all subjective tests, it depends greatly on the accurate cooperation of the patient. The examiner should previously practice the test on himself, and learn to take into account in the evaluation of results the effects of retinal fatigue and the brightness of the light.

When I spoke of this test to my colleagues at the hospital, they informed me that they had been told of this application by an oculist in Pittsburgh.[1] Granting him the priority due him, I nevertheless offer this as an independent, original test. A careful search has failed to reveal previous description, though it seems strange that so simple a procedure should have escaped trial through so many years.

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1. In a paper on the title "Autoophthalmoscopy: Subjective Examination of the Retina" (Am. J. Ophth. **5**:973 [Dec.] 1922) Dr. Eber recalls the method of visualizing the vascular tree of the retina, and suggests that it might be of use in cataractous eyes for the diagnosis of intra-ocular diseases.

Ophthalmologic Review

NYSTAGMUS OF OCULAR ORIGIN*

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In an attempt to integrate the present knowledge concerning nystagmus, Fox suggested the following classification, based on the probable sources of origin:

I. Nystagmus of vestibular origin
  A. Physiologic (induced)
    1. Rotational
    2. Caloric
  B. Pathologic (spontaneous)
    1. Labyrinthitis
    2. Vestibular nerve irritation

II. Nystagmus of optic origin
  A. Physiologic
    1. Optokinetic
  B. Pathologic (spontaneous; pendular type)
    1. Relating to dim light (acquired)
      (*a*) Miners' nystagmus
      (*b*) Spasmus nutans
    2. Due to impaired vision
      (*a*) Congenital ocular defects
      (*b*) Disorders of visual acuity and the visual fields

III. Nystagmus of neuromuscular origin
  A. Physiologic
    1. Positional ("Endstellungsnystagmus")
  B. Pathologic
    1. Weakness of extra-ocular muscles

IV. Nystagmus of cerebellar origin
    1. Lesions of cerebellum
    2. Involvement of cerebellar connections in brain stem

V. Nystagmus of uncertain origin
    1. Toxic states
    2. Cerebral lesions
    3. Disease of the high cervical portion of the spinal cord
    4. Hysterical and voluntary nystagmus

* Submitted for publication, Dec. 9, 1930.

* From the Department of Ophthalmology, Northwestern University Medical School.

The general appellation, "ocular nystagmus," properly includes the types of nystagmus listed in the second and third divisions of the foregoing classification. Each type is caused by a somewhat different mechanism, and it would avoid confusion if, in the literature, the term ocular nystagmus was used only in the general sense and each special type was referred to by its distinctive designation.

The nystagmus associated with disorders of vision is characteristically of an undulatory or pendular type. Miners' nystagmus and spasmus nutans depend on long exposure to poor illumination. The explanation given by Fox is plausible: "In dim light, vision is effected by means of the rods rather than the cones, and since there are no rods at the fovea, it is necessary for the axes of the eyes to be shifted constantly from their primary position." Miners' nystagmus is characterized by short and very rapid oscillations, up to 400 per minute. It generally disappears after a time if the mines are better illuminated, or if the patient changes from this type of employment. In infants that live in dark dwellings spasmus nutans may develop in the winter months. Both the nystagmus and tremor of the head cease when the eyes are closed.

Congenital amblyopia is frequently associated with oscillatory nystagmus, which develops about the third week after birth, when the infant attempts fixation. Ehlers suggested that this might well be termed "amblyopic nystagmus." Acquired amblyopia, however, is not accompanied by nystagmus. In blindness, as contrasted with amblyopia, the reverse conditions hold: The congenitally blind have no involuntary ocular movements, whereas those afflicted with acquired blindness frequently show a "roving nystagmus."

The fine nystagmic movements that occur in most normal persons when the eyes are rotated to an extreme position has been called "pseudonystagmus," but a better term is the German "Endstellungsnystagmus," accurately enough translated as positional nystagmus. The quick jerk is in the direction of gaze. Fox held that the slow phase is probably due to the reflex contraction of the overstretched antagonists, while the quick phase represents attempts of the agonists to maintain fixation. Similarly, a fine nystagmus occurs near the limit of action of a paretic muscle, the slow component being in the direction of the antagonist, while the paretic muscle attempts to avoid diplopia by a quick return jerk.

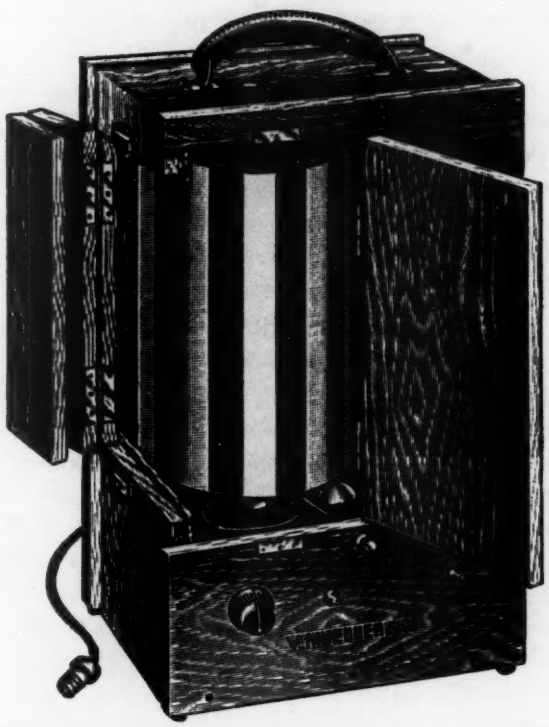
The rhythmic nystagmus evoked when the eyes regard a series of passing objects, though long known, has only recently been the subject of extensive study. Purkinje noted this nystagmus in the crowds watching long processions of cavalry. Javal and Helmholtz observed the phenomenon in those looking at moving trains, and in railway

passengers viewing the scenery. Bárány, in 1907, however, was the first to investigate in detail this reaction, which he called "railroad nystagmus." As this nystagmus is readily reproduced in the laboratory by gazing at a revolving striped cylinder, his term has been considered of too limited connotation by later workers. At the last International Congress of Ophthalmology at Amsterdam, the designation, "optokinetic nystagmus" was favored, and this authorized nomenclature will probably soon displace all other terms previously used.

Unlike the other forms of ocular nystagmus, optokinetic nystagmus is characterized by a biphasic rhythm similar in type to a well defined nystagmus of labyrinthine origin. The eye fixes on one of a series of moving objects, pursues it to the limits of the visual field, and then by a rapid saccadic movement returns without pause to its primary position and repeats the cycle. The slow component is in the direction of the moving objects, and the fast component in the contrary direction. The duration of the fast component is about 0.1 second, and the duration of the slow component, from one and one-half to two times that. Both optokinetic and labyrinthine nystagmus represents ocular reactions to movement: in the former case, movement of the surroundings, and in the latter, movement of the subject. In both types, the nystagmus is strengthened when the gaze is in the direction of the fast component, and disappears when the eyes fix on a near point. However, except for slight vertigo, optokinetic nystagmus is easily tolerated, and may continue for hours without accompanying systemic phenomena, or visible after-effect, while vestibular nystagmus gradually dies out during protracted rotation at constant speed, and shows a characteristic reverse after-nystagmus when rotation is stopped. Labyrinthine nystagmus begins after a latent period of 0.06 second; the latent period of optokinetic nystagmus is from 0.2 to 0.5 second. The two nystagmic types, though similar in appearance, not only arise from different sources, but are mediated through different neural pathways. Optokinetic nystagmus requires participation of the cerebral cortex; when the attention is relaxed it forthwith ceases. The vestibular variety, on the other hand, involves only subcortical pathways, and both slow and fast components can still be obtained after the connections with the cerebrum have been severed (Ivy, Magnus).

To elicit optokinetic nystagmus one requires relatively simple apparatus. Borries, using a foot rule covered with transverse stripes, alternately black and white, observed nystagmus as he passed it before the eyes of his subject. Following this suggestion, I have effectively used at the bedside the back of a hand arc perimeter. Bárány placed his stripes on a revolving cylinder; others have employed a kymograph similarly fitted. Brunner constructed a drum like a lampshade, large

enough to encircle the head, and placed the stripes on the inner surface. This form, in a folding model, has been prepared for use in the office or at the bedside. In a modified apparatus, the subject himself causes the drum to revolve by turning a crank. Drs. Sherman Shapiro and S. J. Pearlman of Chicago have devised a portable model that has much to commend it (see accompanying illustration). It is run by an electric motor, which can be regulated to any speed, reverses direction and permits of accurate timing. Interchangeable paper covers allow the black and white stripes to be of various dimensions. To obtain a



Apparatus for inducing optokinetic nystagmus. This portable electric model designed by Shapiro and Pearlman permits of quantitative study.

vertical instead of a horizontal movement of the stripes, one turns the apparatus from end to side. A rectangular diaphragm, the aperture of which is adjustable, may be placed before the revolving stripes to control the size of the visual image.

The direction of optokinetic nystagmus follows that of the moving objects, and accordingly may be horizontal, vertical or diagonal. Rotatory nystagmus, however, cannot be elicited. If one regards the revolving spokes of a wheel, the nystagmus is simply horizontal, vertical or diagonal according to the direction of gaze. Vertical nystagmus is less readily induced than horizontal, and upward nystagmus is less

active than downward. According to Ehlers, when two stripes per second revolve horizontally before the eyes, the nystagmic movements are seventy-five per minute. By plotting out the nystagmic response to various speeds, a characteristic curve results, consisting of a steady rise, a long plateau and a rapid descent. When the speed is so great that the contrasting black and white are no longer readily discriminated, nystagmus ceases. In a quantitative study of optokinetic nystagmus, Roelofs and van der Bend used as a standard the maximum speed at which nystagmus is still obtainable. They found a definite relation between the angular size of the image and this speed expressed in angular traverse per second, the ratio being about 1 : 3. They found optokinetic nystagmus stronger when the object moves from right to left than vice versa. They expressed the belief that this is due to the fact that in reading and writing one habitually directs one's attention to stimuli in the right halves of the visual field. If this interpretation is true, it would be interesting to observe whether Semitic people show the reverse. The most favorable condition for the production of nystagmus is between three and twelve images per second; above forty the images run together. Black and white stripes of equal width present the most favorable arrangement. The distance of the subject from the drum is unimportant. Lighting is a minor factor, though with brighter illumination, the nystagmus is more active. Fogging the eyes with spheres up to 12 diopters does not affect the nystagmus, which demonstrates that the sharpness of the retinal image is not of great influence. When the screen is adjusted to permit a large field, the maximum and optimum speeds for nystagmus are wider apart than when a smaller field is used. When the field is so narrowed that two stripes cannot be seen at one time, no nystagmus results.

As an objective test for vision, optokinetic nystagmus is as valuable as the pupillary reflex. It can be elicited when the visual acuity is as low as 10/200, and also in the presence of a central scotoma and large field defects. Without training it can be evoked in birds, reptiles and idiots, and in clouded mental states. Though moving stripes do not arouse a dog's attention sufficiently to induce nystagmus, rabbits revolving on a carousel are effective. In the new-born, optokinetic nystagmus can be produced several hours after birth, which argues against Flechsig's theory that unmyelinated nerve fibers do not function.

In paralysis of one muscle the antagonist produces nystagmus in both directions. When an eye, completely immobile, regards the moving objects, while the normal eye is covered, Ohm observed that the nystagmus is transmitted to the covered eye. If the suggestion of Dunn is of any value, that paretic ocular muscles be stimulated by induced vestibular nystagmus, it would appear that optokinetic nystag-

mus, which is better controlled and not disturbing, could be used to greater advantage.

Bárány proposed the test of optokinetic nystagmus to distinguish amblyopic from vestibular nystagmus. In congenital fixation nystagmus, either no essential change results or nystagmus ensues in the direction of the moving stripes instead of the reverse. In this "inverted nystagmus," the eyes follow the stripes, but return only slowly because of deficient ability of fixation. In vestibular nystagmus, the effect produced depends on the strength of the optokinetic impulse. If the optokinetic impulse is rather weak, it will be neutralized by a vestibular nystagmus in the opposite direction, but if the optokinetic nystagmus is more pronounced it will reverse the direction of the vestibular nystagmus. The influence of the labyrinth on optic fixation has been stressed by Ohm, who suggested that fusion defects may be due to a lack of connection between the vestibular centers and the descending central visual radiation fibers. The high incidence of squint (42 per cent) that occurs in spontaneous ocular nystagmus would tend to support this view. Ohm assumed that not only labyrinthine, but also voluntary and optical impulses discharge in or near Deiters' nucleus, and thence by way of the median longitudinal bundle influence the ocular muscles.

The neural pathway involved in optokinetic nystagmus has been the subject of much study. In certain cerebral lesions, nystagmus may be elicited in one direction but not in the other. Hemorrhages in the motor zone of the eyes (middle and inferior frontal convolutions) and in the sensory zone (angular gyrus of the parietal lobe) cause a laterogyric action, that is, produce a rotation of the head and eyes toward the side of the lesion "as though the patient looked at his lesion." The phenomenon disappears in about ten days but for quite a while afterward optokinetic nystagmus to the opposite side cannot be elicited. Stenvers reported a series of cases in which lesions situated in the region of the posterior end of the sylvian fissure (supramarginal gyrus and gyrus angularis), either associated or unassociated with hemianopia, caused a loss of optokinetic nystagmus to the opposite side. Wernoe believed that the angular gyrus is not involved, since in a case of his with destruction of this region through a gliosarcoma, optokinetic nystagmus was normal. Lesions of the frontal lobe, especially when situated in the region of the motor area of the eye, likewise affect optokinetic nystagmus. In one of Cords' cases a tumor of the splenium caused a loss of optokinetic nystagmus to both sides. On the basis of these pathologic observations it seems probable that the optic neurons which end in the occipital cortex are connected by association bundles with the higher visual cortex on the same and opposite sides (to the latter by way of the splenium). An association bundle probably also connects the higher

visual cortex of each side with the ocular centers in the prerolandic gyrus of the same side. Lesions along any part of one sensory path cause no loss of optokinetic nystagmus, but lesions affecting the higher visual cortex, their association fibers or the motor path to the nuclei of the ocular muscles will cause this loss.

Graphic records of nystagmus have been obtained by a lever attached to the upper lid (Ohms), by photographing the reflection of a concave mirror similarly secured (Dodge) or by connecting the temples with the string galvanometer used in electrocardiography (Meyers).

Clinically, then, the test for optokinetic nystagmus should be of value in the following conditions: (1) to expose malingering in cases of assumed blindness; (2) to differentiate between nystagmus of vestibular origin and congenital fixation nystagmus; (3) to determine the existence of lesions in the optometer pathway, likewise to differentiate hemianopia due to lesions of the optic tract or optic radiation from hemianopia of cortical origin; only in the latter is there an absence of the quick phase on the hemianopic side; (4) possibly to stimulate paretic ocular muscles.

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News and Notes

EDITED BY DR. JOHN HERBERT WAITE

GENERAL NEWS

Fourteenth International Ophthalmological Congress.—The subjects for discussion at the fourteenth meeting of the Congress at Madrid, in 1933, will be detachment of the retina and tuberculosis of the iris and ciliary body. Members who have not yet received a copy of the transactions of the last congress are requested to communicate with the Secretary of the International Ophthalmological Congress. Nonsubscribers may procure a copy at the price of 16 dollars.

First Congress of Ophthalmology of Latin America.—The first Congress of Ophthalmology of Latin America will be held at Santiago, Chile, in the spring of 1932.

White House Conference on Child Health and Protection.—This conference was called by President Hoover as an extragovernmental function, and its work has been financed from private sources. The purpose of the conference was to study the present status of the health and well-being of the children of the United States, to report what is already being done to promote the health of children and to recommend what ought to be done and how to do it. The Section on Medical Service of the White House Conference held its final session at Washington, D. C., Feb. 19 to 21, 1931. Other sections deal with public health service; education and training, and prevention, maintenance, and protection of the handicapped. The reports of the various sections are being edited for publication.

Instruction in Ophthalmology in Hospitals, Paris.—The following courses are offered in the various hospitals in Paris: Ocular physiology: nine exercises by Drs. Bailliart, Magitot and Mawas during May, 1931. Surgery of the Eye (ten lessons): instruction in English daily, July 1 to 11, 1931, by Drs. Morax, Magitot, Bollack and E. Hartmann; fee, 500 francs. General Ophthalmologic Subjects: a six weeks' course from Nov. 2 to Dec. 7, 1931, by Drs. Morax, Poulard, Bollack, E. Hartmann, Magitot, Bailliart, Parfonry, Joseph and Lagrange; fee, 1,000 francs.

Second International Hospital Congress.—Invitations are out for the Second International Hospital Congress, to be held in Vienna, Austria, from June 8 to 14, 1931. Great interest was directed toward general and special hospital problems at the first congress held at Atlantic City in June, 1929, and attended by representatives of thirty-six countries. The coming congress will consider building costs, nursing, legislation, maintenance costs of patients, dispensaries, nutrition and other problems.

American Board for Ophthalmic Examinations.—The American Board for Ophthalmic Examinations will hold an examination at Philadelphia on June 8, and at Denver on July 23, 1931. Information may be obtained from the Secretary, Dr. William H. Wilder, 122 South Michigan Avenue, Chicago.

International Trachoma Prize.—The Royal Hungarian Minister of Public Welfare and Labor offers a prize of 2,000 Swiss francs as a reward for independent and valuable work on the etiology of trachoma. Essays submitted for the competition may be written in English, German, French, Italian or Hungarian, and they must be submitted not later than June 30, 1931, to Eye Clinic no. 1, Royal Hungarian Peter Pazmany University, Budapest (VIII, Maria-utca 39). Works that have already appeared in print are eligible for this competition. The jury of award, appointed by the Royal Hungarian Minister of Public Welfare, consists of Dr. Arthur F. MacCallan of London, Dr. Victor Morax of Paris, Prof. Dr. L. Maggiore of Bari and Prof. Dr. Carl Prausnitz of Breslau. This jury is at liberty to consider works not submitted for competition, but appearing in print between the dates of July 1, 1929, and June 30, 1931. The decision of the jury will be announced not latter than Dec. 31, 1931.

New Ophthalmic Research Institute and Hospital.—The $1,500,000 fourteen story building for the McMillan Hospital and Oscar Johnson Institute of Washington University, St. Louis, was opened in January. On the first and ground floors are eye, ear, nose and throat clinics, administration offices, kitchens and service rooms. The second floor has 6 operating rooms, an auditorium seating 120 persons, a conference room and locker rooms for visiting physicians, nurses and medical social workers. The next five stories provide 150 beds, two floors being for private and semiprivate patients, one for Negroes, one for white ward patients and one for the care and study of patients with infectious diseases of the eye, ear, nose and throat. The upper six floors will house the Oscar Johnson Institute for research and teaching of ophthalmology and otolaryngology. Three of these floors are being used for research in chemistry and bacteriology in a comprehensive investigation of trachoma. A roof garden furnishes recreational facilities for the staff and a sunparlor for the patients.

The following appointments, among others, are listed for the department of ophthalmology: George Holman Bishop, Ph.D., Dr. Percy Wells Cobb, Dr. Harvey D. Lamb, Louis A. Julianelle, Ph.D., and James A. Hawkins, Sc.D. Rossleene A. Hetler, Ph.D., will have charge of the chemical studies of vitamin and food deficiencies and of the allergies in relation to ocular diseases. Dr. Harvey J. Howard will direct research in ophthalmology.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

MODELS ILLUSTRATING THE DEVELOPMENT OF THE NORMAL EYE AND ITS MALFORMATIONS. A. VON SZILY, Klin. Monatsbl. f. Augenh. **85:** 210 (Aug.) 1930.

Models were made from plate reconstructions of microscopic sections of the eyes. The first series represents the development of the "primitive and epithelial disk" of a rabbit. Three models of this series show the "Becher," magnified 200 times, in the embryo at the age of 12, 13 and 14 days. The second series, consisting of five models, shows the development of coloboma, microphthalmia and orbital cysts. The material was gained by breeding animals, afflicted with coloboma, after the method employed first by E. von Hippel. Three of these models represent the appearance of the malformations on the seventeenth, eighteenth and nineteenth day in the rabbit embryo. These were chosen from a collection of 55 plate reconstructions made by the author. The fourth and fifth model show the conditions on the twenty-fourth and twenty-sixth day, respectively, magnified 50 times, while the first three models of this series are twice this size. All models are shown in pictures appended.

K. L. STOLL.

Conjunctiva

PHLYCTENULOSIS AND ITS RELATION TO TUBERCULOSIS. M. GOLDENBURG, Am. J. Ophth. **13:** 699 (Aug.) 1930.

The author refers to his previous work on phlyctenulosis and states that he is still of the opinion that it is not due to tuberculosis, as proof has not been adduced to show such an etiology. He calls attention to the fact that children without phlyctenular disease have positive reactions to the Pirquet tests, and in a series of cases he found that these children had about the same percentage of positive reactions as did those with phlyctenulosis. He has not been impressed by the use of tuberculin. He believes the best treatment to be the application of atropine locally and mild mercurous chloride in small doses internally, with regulation of the diet. He has been able to obtain cures in these cases by cutting down carbohydrates, and to reproduce it by administering carbohydrates. The remainder of the paper deals with data refuting tuberculosis or a tuberculous toxemia as the cause of phlyctenular disease.

W. S. REESE.

ON THE PIGMENTATION OF THE CONJUNCTIVA IN NORMAL INDIVIDUALS AND IN CASES OF KERATOMALACIA IN ADULTS. E. PUSCARIU and J. NITZULESCU, Brit. J. Ophth. **15:** 18 (Jan.) 1931.

The authors report a case of conjunctival xerosis in which pigmentation was noted in a farrier 68 years of age. The conjunctiva of the

everted lid had a papillary, vegetant appearance. On the lateral part near the corneal limbus was a small xerotic lesion covered with the characteristic foamy deposit. Near to it was a larger white dim nodosity. Around both was a heavy blackish-brown pigmentation. The fissural bulbar conjunctiva was yellowish brown. The corneal limbus was also pigmented, and the plica and tarsal conjunctiva were pigmented. Crystals of cholesterol were not found.

With the biomicroscope the pigment appeared as a diffuse, yellowish, uniform infiltration on which were spread irregular darker spots. The adaptometer showed a difference of 15 points from the normal eye.

The patient was a gipsy, a race which is naturally pigmented, and the authors believe this explains why the xerosis showed pigmentary changes. These people show usually a brown blackish tinge to the fissural portion of the bulbar conjunctiva—the part exposed to light.

The patient's usual diet consisted of corn, potatoes, soups and, less frequently, green vegetables.

The authors are inclined to accept Pillat's opinion that the xerophthalmic pigmentation is due to melanin, and think that the abnormal pigmentation seen in xerophthalmia in the colored people should be considered as the manifestation of a special reaction, the intensity of which varies according to the particular capacity of the trophopigmentary tissue of different races, being most reduced in the white race.

W. ZENTMAYER.

SPRING CATARRH AND HEBRA'S PRURIGO. J. VERDAGUER, Arch. de oftal. hisp. am. **30:** 233 (May) 1930.

The author calls attention to the constant association which he has observed at Charlin Clinic, Santiago, Chile, of Hebra's prurigo, especially of the so-called French type, with facial and brachial localization, and spring catarrh, the hematologic formulas coinciding. He reports two cases of this combination.

C. E. FINLAY.

Congenital Anomalies

A CASE OF MICROPHTHALMOS. P. SANDER, Brit. J. Ophth. **15:** 22 (Jan.) 1931.

The family history makes this case of bilateral microphthalmos of interest. In the second month of the pregnancy the mother watched an operation for acute glaucoma on her mother's eye. The operation was complicated by the copious loss of vitreous and subsequent loss of the eye. It then became a fixed idea with the mother that her baby would have something wrong with its eyes. During her only pregnancy she frequently experienced apprehension for the eyes of her future child. When born, the baby "had no eyes." The child died from an acute infection.

W. ZENTMAYER.

CONGENITAL ENTROPION. GOMEZ MARQUEZ, Arch. de oftal. hisp. am. **30:** 187 (April) 1930.

After referring to the infrequency of congenital entropion, the author reports two cases. One case was that of bilateral entropion of both lower lids, in which cure was obtained by excision of a horizontal

fold of skin and muscle parallel to the margin of the lid, supplemented in one eye by section of the tarsus, with a good final result. The second case was one of a monocular entropion of the lower lid, the margin of which was fixed to the orbital rim. In this case the author made a long incision between the palpebral and the bulbar conjunctiva down to the orbital margin, liberating the lid; a fibrous band which fixed the eyeball to the lower orbital wall was sectioned, and a mucous flap from the mouth was inserted into the breach and fixed with sutures. A slight entropion which persisted was later corrected by transplantation of the internal half of the margin of the lid according to the technic of Spencer Watson, by enlargement of the lower culdesac with transplantation of a mucous flap from the upper lid. Later after several operations for a coexisting strabismus, a satisfactory result was obtained.

In commenting on these cases, the author differentiates two classes of congenital entropion: (*a*) essential entropion with normal lids, and (*b*) symptomatic, which coexists with other palpebral malformations. The first is similar in nature to senile entropion, the second to cicatricial entropion. The treatment is surgical, either the author's procedure or Aubineau's flap with a pedicle, after liberation of the lid margin, being used.

C. E. FINLAY.

Experimental Pathology

UNILATERAL ANGIOSPASTIC PARALYSIS OF THE FOURTH NERVE WITH BILATERAL CHOKED DISK FOLLOWING A FALL ON THE BACK OF THE HEAD. D. MICHAÏL, Arch. d'opht. **47**: 385 (June) 1930.

The history of a patient, aged 52, with hypertension, who sustained an injury to the head from a fall which produced unconsciousness, bilateral choked disk, paralysis of the left superior oblique muscle and headache, is first presented. The author then proceeds to discuss the possible explanations for increased intracranial pressure in such cases. In his case, he believes that the injury disturbed the secretory balance of the choroid plexus, so that a hypersecretion of spinal fluid resulted. He suggests that the process may be similar to that which takes place in traumatic glaucoma.

He points out that isolated paralysis of the fourth nerve is a rare occurrence following an injury to the head. The possible etiologic factors are discussed, and, as a result, the author inclines to the belief that in his case it was due to spasm of a small vessel which supplies the nucleus of this nerve.

S. B. MARLOW.

EXPERIMENTS ON VARIATIONS IN THE TENSION OF THE EYE PRODUCED BY VASCULAR DRUGS. ANTONIO OLIVERES PALLARÉS, Arch. de oftal. hisp. am. **30**: 443 (Aug.) 1930.

Reference is made to the syndrome that Loepev and Bauman described as lyasthenia, produced by atony of the fibers of the smooth muscles, with vascular dilatation and a consequent reduction in the arterial tension. The author had been able to determine this syndrome in a number of patients with glaucoma. He performed the following experiments on two rabbits: After a preliminary determination of the ocular tension, which was found to be from 15 to 17 mm., amyl nitrite

was administered for thirty seconds, with the consequent general symptoms. At the end of one minute the ocular tension had risen to 35 mm., requiring two hours to return spontaneously to normal. An injection of 5 drops of epinephrine, in three minutes, brought the increased ocular tension down from 35 to 18 mm., and in five minutes to the preliminary 16 mm.

From this the author infers that glaucoma is only a local manifestation of lyasthenia, and that the administration of ergotinine and tartrate of ergotamine is indicated.

C. E. FINLAY.

General Diseases

TYPICAL AND ATYPICAL OCULAR TUBERCULOSIS. J. GOMEZ MARQUEZ, Arch. de oftal. hisp. am. **30**: 17 (Jan.) 1930.

The author divides tuberculous ocular lesions into two large groups: 1. The first group is characterized by typical tuberculous lesions, with the presence of bacilli and histopathologic lesions of a progressive and destructive nature. These lesions are similar in every respect to pulmonary tuberculosis, and fortunately are rare. 2. The second group is composed of nonmalignant ocular diseases that are usually considered as suggestive of tuberculosis and some that are not. In this group there is a tendency toward recovery; there is follicular formation and no tubercle bacilli; the disease follows a chronic or acute course and attacks scrofulous and apparently healthy persons.

From a consideration of Koch's phenomenon in connection with tuberculin inoculation of healthy guinea-pigs and those previously tuberculized, he concludes that different types of ocular tuberculosis are explainable by the different relations between the two factors: allergy and immunity.

In cases of early infection, the functional defenses of the organism are exalted, and not only is the germ defeated but the patient acquires immunity and becomes nonallergic.

In other cases the tuberculized child also recovers from his first attack and is rendered immune, but his tissues have been sensitized or rendered allergic, and new inoculations are followed by more or less violent inflammatory reactions, which vary according to their site, and which are not characteristic of tuberculosis.

In still other cases, the tuberculized child acquires only a partial immunity, with or without allergy. When later the number of bacilli attacking his organism is small, his defensive resources prove sufficient and he can resist their invasion, but if they are more numerous, he will be unable to resist the attack and typical tuberculous lesions make their appearance in the organs in which the inoculation takes place. Among the ocular lesions of this class is to be found parenchymatous keratitis, which the author considers to be of a tuberculous nature as often as of a syphilitic nature.

In connection with the diagnosis of atypical tuberculosis, in cases in which it is impossible to find tubercle bacillus or the elementary follicle and in which a serodiagnosis, a seroprecipitation, the opsonic method, the fixation or antigen reactions, Pirquet's or Mantoux's test may simply indicate a state of allergy or relative immunity originating from the

primary infection, the author considers an appeal to the effects of treatment justifiable, which at the same time confirms the specific action of the remedies employed.

Inspired with these ideas, the author has for several years employed the immunizing bodies of Spengler, which consist in extracts of red blood corpuscles of animals intensely tuberculized. His experiments started in 1919 with cases of phlyctenular ophthalmia. At first he employed them in subcutaneous injection but later used them per os. The method employed is as follows: After first eliminating the possible presence of an active tuberculous focus and after determining the nonexistence of a rise of temperature, above 37 C., the treatment is commenced with Ferran's solution no. 7, 1 drop in a little sugared water on rising. The dose is increased daily till 20 drops are given, the weight and temperature being carefully watched. Then he commences with a drop of solution no. 6, and the dose is daily increased in the same manner till solution no. 1 is reached. If any febrile reaction appears, the drug is suspended until the fever disappears, then it is continued; if the fever reappears, it is definitely stopped. Under this treatment, the phlyctenulae disappear early and never return. Hundreds of patients have been treated in this manner. All of the patients increase in weight.

In a few cases, after the first doses, the patient becomes pale, and a rapid pulse develops; in girls, menstruation is suspended. If these symptoms appear the drug should be discontinued.

Similar but not so favorable results were obtained in other ocular diseases of a possible tuberculous nature, such as keratites, irites and torpid choroidites. In these the author first employed tuberculin, not very successfully, especially Beraneck's, which he considers somewhat dangerous. For the last two years he has employed intravenous injections of sodium aurothiosulphate, especially in cases in which there is resistance to the immunizing agent. The results of this treatment will be dealt with in a future paper.

C. E. FINLAY.

Glaucoma

SOME PHASES OF SECONDARY GLAUCOMA. W. H. WILDER, Am. J. Ophth. 13: 681 (Aug.) 1930.

The author classifies secondary glaucoma as (1) mechanical and (2) biochemical or inflammatory, and gives five examples under the first mentioned cause: (1) intra-ocular tumors, of the iris, the ciliary body, the choroid or the retina; (2) prolapse of the iris through corneal wounds, the anterior synechiae or the posterior synechiae, with seclusion of the pupil; (3) intumescent cataract and traumatic cataract; (4) subluxation of the lens either partial or forward into the anterior chamber; (5) postoperative glaucoma (*a*) after extraction of the cataract, with entanglement of the iris or the capsule in the wound, (*b*) after discission of the capsule and (*c*) from a downward growth of the epithelium into the anterior chamber through the corneal wound after extraction of the cataract. He discusses the manner in which hypertension is produced in these cases. Under the second heading, uveitis and the theories as to the production of tension are discussed. In the treatment for the second type of glaucoma, the author uses homatropine cautiously. If a miotic is necessary, he prefers pilocarpine. Dionin

is used and epinephrine is avoided, though levoglaucosan is used to break up adhesions of the iris that do not yield to mild mydriatics. The surgical treatment is discussed briefly.

W. S. REESE.

EPHEDRINE AND GLAUCOMA. A. BARLOW, Am. J. Ophth. **13**: 687 (Aug.) 1930.

The author reports five cases of acute glaucoma occurring after the use of ephedrine nasally. All of the patients were Jewish; four were females. All of the patients recovered, two after having undergone operation. The author suggests that ephedrine, like atropine, may excite an attack of glaucoma in a person with a glaucomatous predisposition. All of the patients had continued to do well, though none of them continued to use miotics.

W. S. REESE.

Injuries

FOREIGN BODIES IN UPPER CONJUNCTIVAL FORNIX. THOMAS COLLEY, Brit. M. J. **2**: 600 (Oct. 11) 1930.

The author calls attention to the facility with which foreign bodies in rural districts, like particles of straw, etc., can get into the upper fornix and be overlooked. After a time they produce definite symptoms. As the sensitiveness of this part of the conjunctival sac is comparatively low, and the foreign bodies are well away from the cornea, their presence is often undetected. The clinical picture that results is fairly typical. The discharge is usually mucopurulent. The upper lid is swollen and puffy. The lashes stick together, but the conjunctiva seems fairly healthy, excepting in the region of the upper fornix. In some cases, ulceration takes place, and the foreign body is embedded in granulation tissue.

The author reports two cases and concludes with the statement that the possible presence of a foreign body in the upper fornix must not be overlooked in the case of mucopurulent discharge, in the absence of dacryocystitis.

A. KNAPP.

CILIA IN THE ANTERIOR AND POSTERIOR CHAMBERS. E. PANICO, Ann. di ottal. e clin. ocul. **58**: 417 (May-June) 1930.

The author has observed one case each of cilia in the anterior and posterior chambers, both the result of corneal wounds. In both cases the cilium was tolerated with no harmful results. Panico introduced human cilia into the eyes of rabbits, by passing a needle on which the cilia were threaded, into the anterior chamber and out again. The cilia were left with both ends adherent to the cornea, or with only one end adherent or entirely free in the chamber. In all cases there was a slight reaction which subsided entirely after a few days, except where one free end touched the iris, when a slight hyperemia of the iris persisted longer. No signs of cyst formation were seen during seven or eight months.

The author concluded that the small number of organisms usually carried into the chamber are disposed of by the local defense processes, and hence there is no need to remove cilia that are apparently causing no reaction.

S. R. GIFFORD.

Lens

COLORED CRYSTALS ON THE ANTERIOR SURFACE OF THE LENS AFFECTED BY SENILE CATARACT. P. SANDER, Brit. J. Ophth. **15:** 26 (Jan.) 1931.

A woman, aged 62, had bilateral nuclear cataract. The biomicroscope showed great numbers of crystals of various shapes and sizes. The colors were variable: cherry red, light red, deep yellow, sky-blue, blue green and pure green. The crystals scintillated on movement of the globe and on oscillating the beam of light. They were on the anterior surface of the lenses. None were found in the anterior chamber or in the substance of the lens. Five months later the crystals had disappeared.

W. ZENTMAYER.

A SHORT STUDY OF THE COMPLICATIONS OF CATARACT EXTRACTION IN EGYPT WITH SOME PRACTICAL SUGGESTIONS. H. PÉRETZ, Brit. J. Ophth. **15:** 28 (Jan.) 1931.

Only 9.8 per cent of the operations at Alexandria were for senile cataract, whereas in Munich the percentage is 35.9. The author points out that this discrepancy can be accounted for partly by the fact that 30 per cent of the Egyptian patients over 45 years of age have only one eye, the other being lost from atrophy, glaucoma, detached retina, etc. In the remaining eye the presence or absence of cataract cannot always be determined because of dense leukoma. Moreover, many persons with cataract do not apply for treatment. He therefore believes that cataract is as common in Egypt as in Europe.

Among the complications are trachoma, rebellious blepharoconjunctivitis, stenosis of the lacrimal passage and dacryocystitis, phimosis of the palpebral fissures and symblepharon. The bulbar conjunctiva is often friable as a sequel to disease and treatment. Pannus is frequent, and chronic glaucoma is present in 40 per cent of aged patients. Myopia in Egypt is a hereditary disease.

W. ZENTMAYER.

Methods of Examination

REFLECTIONS ON BIOMICROSCOPY OF THE CRYSTALLINE LENS. DUVERGER and VELTER, Arch. d'opht. **47:** 418 (July) 1930.

The methodical study of the crystalline lens with the slit-lamp leads to the study of cataract with an exactness that is of great interest from several points of view. After indicating the variety of advantages derived from such an examination, the authors raise the question as to whether or not all the varying modifications of transparency revealed should be called cataracts or not. In their opinion only those types of changes that are likely to lead ultimately to a true cataract should be called by this name. All others should be called opacities for want of a better term.

Although they are aware that it is artificial and that there are many limitations and gaps in our knowledge about them, the authors present a classification which they believe will be useful and satisfactory for clinical use. Their classification is then presented, each type being clearly described. A footnote states that the ideas developed in this

article were supported in the discussion which followed the presentation of the report at the meeting of the French Ophthalmological Society in May, 1930. The accompanying plates were printed through the courtesy of Dr. Onfray.

S. B. MARLOW.

PROGRESSIVE EXOPHTHALMIA DUE TO NEW GROWTH IN THE FRONTAL LOBE. F. TERRIEN, P. SAINTON and P. VEIL, Arch. d'opht. **47**: 434 (July) 1930.

This paper is the report of a case of a man 64 years old who had an extreme proptosis of his right eye, of thirty-eight years' duration, due to a mass occupying the whole region of the frontal lobe which had completely destroyed the roof of the orbit and invaded the whole upper half of this cavity. In spite of the extension of the lesion, the eyeball remained intact, vision essentially normal, and the disk with the retina entirely intact without any trace of edema or choked disk on either side. In spite of the extension of the lesion forward up to complete destruction of the external table of the frontal bone in places and up to the vicinity of the sella turcica as shown by stereoscopic roentgenograms, there was no sensory disturbance in the area supplied by the first branch of the fifth or of the olfactory nerve, nor any general nervous disorder, nor symptoms referable to the pyramidal or extrapyramidal tracts. Only the presence of a complete homonymous hemianopia in the right eye with conservation of the macula, appearing suddenly three months before, suggested an extension of the original lesion toward the left optic tract. This, the authors believe, can be explained by hemorrhage. The differential diagnosis is discussed. The patient was not subjected to operation because of the extent of the lesion.

S. B. MARLOW.

Operations

SIMPLE TARSECTOMY: ITS IDICATIONS AND TECHNIQUE. M. BEIGELMAN, Am. J. Ophth. **13**: 677 (Aug.) 1930.

The author gives a brief history of tarsectomy and discusses its value. Its beneficial results are attributed to removal of the hard resistant tarsus which irritates the cornea, and the substitution of a soft, fleshy curtain, and also to local blood-letting followed by an increased supply to the part. In the author's opinion the great value of tarsectomy is due to relief from orbicular pressure on the cornea, as the orbicularis in trachoma is kept in a state of spastic hypertonicity through constant reflexes from the diseased conjunctiva. This is aggravated by the hypertrophy and engorgement of the mucosa, and in later stages by a cicatricial contraction of the total structure of the lid. This pressure causes impairment of the nutrition of the cornea by pressure on its lymphatic channels, thus increasing the possibility of ulceration and the formation of pannus. The author also believes that by doing the operation through an external incision in the lid, many of the bundles of muscles are severed, which with subsequent cicatrization probably interferes with orbicular spasm. He states that tarsectomy prevents and corrects entropion. It should not be done in early trachoma when conservative treatment can be used, but is indicated when corneal involvement occurs. The author is opposed to removal of the conjunctiva.

His technic is as follows: infiltration anesthesia by the injection of 2 per cent procaine hydrochloride-epinephrine, both under the skin of the eyelid and under the cocainized conjunctiva; canthotomy; the introduction of Snellen's large blepharostat; an incision 2 mm. above and parallel to the margin of the lid through the skin and the orbicularis. A few strokes of the scalpel or scissors expose the tarsus. The latter is pulled down with a hook so that its upper convex border is brought out clearly. A slight incision is made with a scalpel to expose the upper margin of the tarsus sufficiently to get hold of it with forceps, and with the knife turned toward the tarsus the latter is carefully dissected from the conjunctiva and excised. Three or four sutures are used to close the wound.

W. S. REESE.

ELLIOT'S TREPHINE OPERATION—A VARIANT. G. BROOKES, Brit. J. Ophth. **15:** 34 (Jan.) 1931.

Because of the necessity at times of trephining an eye more than once to secure a really satisfactory tension, Brookes has devised the following modification of the Elliot operation, to insure a good filtering scar.

After anesthetizing the eye, the conjunctiva is seized as high up as possible and lifted well off the eyeball. Three quarters of a cubic centimeter of a sterile solution of procaine hydrochloride and epinephrine is then injected into the loose areolar tissue, the needle entering half way up the side of the tent, so to speak. The bleb is massaged gently but firmly downward over the limbus. After this, one opens immediately into the superior side of the bleb with one large incision with blunt pointed scissors. These are then inserted closed into the wet pocket and opened laterally; a couple of side cuts allows the flap to be turned down over the cornea. After the field is mopped dry it is surprising how little splitting of the cornea remains to be done with a metal instrument.

The author believes that in this way a permanent and successful bleb is more likely to occur in nature's plane of cleavage which this injection produces, than in any deeper or more superficial one, however gently made. He thinks Elliot's instructions to make the flap as thick as possible at its base a mistake.

W. ZENTMAYER.

IMPLANTATION OF DARK SUBSTANCES INTO THE LIDS OF ALBINOS. R. FRIEDE, Klin. Monatsbl. f. Augenh. **85:** 186 (Aug.) 1930.

Tattooing of the conjunctiva or of the tarsus has not been effective in warding off the light from albinotic eyes. The author tells of inserting black celluloid leaves of 0.1 and 0.3 mm. thickness between the tarsus and orbicular muscle, after dividing the lids with a lance-knife at the intermarginal seam. All four lids may be operated on at the same sitting. Symptoms of irritation will disappear within a short time from the lids and conjunctiva with certain precautions, e. g., in avoiding a lesion of the tarsus. Paraffin, gold or platinum may be used for implantations. Artificial ptosis may be produced to keep the upper portion of the cornea covered, while the lower lids are stiffened by implantation of paraffin to cover the lower portion of the cornea and iris, if desired.

K. L. STOLL.

Orbit, Eyeball and Accessory Sinuses

OPERATIVE TREATMENT OF PULSATING EXOPHTHALMOS. G. M. DORRANCE, Am. J. Ophth. **13**: 675 (Aug.) 1930.

The author discusses the pathology of pulsating exophthalmos rather briefly. He describes the usual procedures as : 1. Ligation of the common carotid on the affected side. This operation is especially of value in the older subject, as a collateral anastomosis is less likely to occur. In the younger patient, following this procedure, the bruit disappears but recurs in a short time. 2. Ligation of the internal carotid. This procedure will practically always reduce the pressure, but as the only collateral circulation possible is through the circle of Willis, one frequently has such a reduced circulation to that portion of the brain supplied by the internal carotid that a hemiplegia occurs. He states that the ligation should be done under local anesthesia and that in the case of the common carotid there should be a gradual cutting off of the blood supply. When the internal carotid is ligated, the wound should be left open. Paralysis usually occurs in the first twenty-four hours, though it may not appear for from twenty-four to thirty-six hours. The author advocates ligation of the common carotid and, within a week or two, of all the branches of the external carotid except the internal maxillary and the superficial temporal, either at one or more sittings depending on the amount of arteriosclerosis present. He states that up to the present this method has proved most satisfactory. Should it fail later, he would ligate the internal carotid without fear of hemiplegia. The author is opposed to the ligation of the veins of the orbit.

W. S. REESE.

Physiology

THE LIGHT SENSE. G. OVIO and E. HERTEL, Ann. di ottal. e clin. ocul. **58**: 387 (May-June) 1930.

The authors have found that the normal eye is able to distinguish the eight grades of brightness in Ostwald's scale, and believe that this examination in daylight or a similar examination with rotating disks as previously described, combined with an examination with test types, gives sufficient information about the light sense.

The various methods of determining the light sense by means of test types are reviewed. Some observers have used standard types, reducing the illumination until they were not visible; others used types of graduated gray on a white or black background. Tscherning's photometric glasses are described, and the studies of his colleagues in which a scale of gray optotypes was also used. In the use of optotypes, the results depend partly on vision and partly on light sense, and the parts played by these two factors are not easy to distinguish. The effect on central vision of reduced illumination has by no means been standardized, as is shown by comparing the tables of several observers. The authors consider the various factors that may account for the decrease in central vision with lowered illumination, the most important, they believe, being the lessened reflection of light, which makes the difference between black and white relatively less than in good light. They describe experiments of their own with rotating disks to prove the point.

The technic of examining the light sense by these various methods is described, including a test without any special apparatus, the perception of ordinary test types being compared with that of the observer under varying degrees of illumination.

The work is an exhaustive review of the entire subject, with bibliography of 142 titles, and is not suitable for abstracting.

S. R. GIFFORD.

ANAGLYPHIC STEREOSCOPIC VISION. M. MARQUEZ, Arch. de oftal. hisp. am. **30:** 465. (Sept.) 1930.

The author first takes up the so-called stereoscopic vision of two slightly dissimilar figures of two dimensions (more properly to be denominated pseudostereoscopic) without the aid of any apparatus, which he explains by a dissociation of accommodation and convergence with (1) accommodation of both eyes for the plane of the stereograms, (2) convergence beyond or closer than this plane and (3) variations in convergence conducive to fusion of the similar points of the stereograms.

He next studies Rollmann's fusion of figures in complementary colors by means of anaglyphic glasses with the resulting stereoscopic fusion, which he considers as a variety of the one just mentioned. He concludes that (1) anaglyphic vision is only a particular example of stereoscopic vision, in which the glasses employed have a color exactly complementary to those of the figures to be observed; (2) fusion is obtained by convergence or divergence according to whether the colors of the glasses are on the same side or crossed in relation to those of the figures: (3) fusion is effected in black for the two figures of complementary colors—the two images of the same color as the glasses being eliminated; (4) convergence fusion, the usual procedure in anaglyphic stereograms, is easier than that of the other variety, owing to the proximity of the figures; (5) anaglyphic stereograms can also be constructed to be seen with divergence fusion.

C. E. FINLAY.

Refraction and Accommodation

GREAT PRACTICAL IMPORTANCE OF BICYLINDRIC COMBINATIONS IN THE DETERMINATION OF REFRACTION. M. MARQUEZ, Arch. de oftal. hisp. am. **30:** 169 (April) 1930.

The author, who claims to have first described biastigmatism (astigmatism of the cornea and lens with oblique axes) at the International Ophthalmological Congress at Naples in 1900 and the use of bicylindric glasses with oblique axes in London in 1913, after referring to several other papers on the subject reported at different ophthalmologic meetings, refers to the comparatively recent work of Lindner and Kramer, who revived skiascopy with cylindric glasses (originally proposed but not carried out by Jackson, Duane and Chibret), detailing his original conclusions and those of Lindner and Kramer. The author insists on the usefulness of his method of exploration of biastigmatism (subjective method), which he considers superior to all others, following ophthalmometry and at times combined with skiascopy.

His conclusions are: 1. The laws regulating the combination of two cylindric lenses can be condensed in the statement that the axis of the resulting cylinder lies in the bisectrix of the angle formed by both axes if they have the same sign and are of equal value, and nearer to that of the higher cylinder when they have the same sign but different values. When the cylinders have a different sign, the value of one of the cylinders is transposed by the addition of a spherical glass of a contrary sign with a reduction to the first condition. 2. The transposition can be effected by (*a*) the already known formulas, (*b*) by Kramer's graphic method for cylinders with a different sign or by Nitsche-Gunter's with cylinders of the same sign, or (*c*) what is most rapid, by means of the Marquez-Busto tables. 3. Cylindric skiascopy, recently revived by Lindner and theoretically studied by Kramer, is one of the most important applications of the laws of cylindric combinations. 4. Another important application is the diagnosis of biastigmatism according to the author's methods: (*a*) the ophthalmometric subjective method, (*b*) the ophthalmometric skiascopic method and (*c*) the purely subjective method.

C. E. FINLAY.

Retina and Optic Nerve

OPTIC ATROPHY WITH RETINAL CHANGES CAUSED BY HIGH-TENSION CURRENT. W. BAINBRIDGE, Brit. M. J. **2**: 955 (Dec. 6) 1930.

In June, 1927, the patient, aged 31, an acetylene burner, received a shock with an electric current of 460 volts alternating current. His left wrist and his toes were burned. His eyes were inflamed for four months, but his sight was not affected. About seven months later his eyes became misty; he was examined by Bainbridge on Oct. 8, 1929. The family history was unimportant. Vision in the right eye was 6/36, and in the left 6/24. The pupils were active. The disk in the right eye was atrophic. There were a large number of rounded white areas in the macular region surrounded by pigment. To the nasal side of the disk was an angioid streak. The fundus of the left eye presented a pallor in the upper half of the disk with similar changes in the macular region of the retina, and angioid streaks on both sides of the disk. There was retinal degeneration in the periphery. Both fields were concentrically contracted. All tests were negative, and the conclusion is arrived at that the condition of the fundus is the result of the accident.

A. KNAPP.

THE ETIOLOGY OF RETINITIS PIGMENTOSA. N. A. PLETNEVA, Arch. oftal. **6**: 471 (April) 1930.

The author believes that retinitis pigmentosa may be a manifestation of dysfunction of the pituitary gland, because it is often associated with various degenerative processes, such as deafness, muteness, idiocy, harelip and dystrophia adiposa genitalis. She found that of sixty-five patients with typical fundic pictures of retinitis pigmentosa roentgenologically 66.1 per cent, or forty-three patients, showed changes in the sella turcica. In the routine roentgen examination of 100 patients with diseases of the eye, without lesions of the fundus, only one showed abnormality. The changes that were noticed in the cases of retinitis pig-

mentosa were approximation of the clinoid processes of the sella with narrowing of the entrance to it. In some cases there were atrophic and degenerative changes of the processes and the back of the sella. Calcification and the formation of the bone of the sella turcica were noticed in some cases.

Hypophysectomy was done in thirty-seven dogs. Dystrophia adiposa genitalis developed in all of them. It was difficult to decide whether they had retinitis pigmentosa, since normally dogs have hyperpigmented fundi. Whenever hypophysectomy was performed on rabbits, they all died on the operating table. The author gave injections of a pituitary preparation and used roentgen therapy in fifteen cases. In only seven cases did she notice a slight improvement and an enlargement of the visual fields.

The author's conclusions are as follows: 1. The changes in the sella turcica in retinitis pigmentosa are not accidental roentgen observations. 2. The character of the changes in the sella suggests compression of the pituitary gland with diminution of the hypophyseal secretion, i.e., hypofunction of the gland. 3. The association of retinitis pigmentosa in patients with defects in the development of the extremities and, also, with dystrophia adiposa genitalis confirms this assumption.

O. SITCHEVSKA

TREATMENT OF EMBOLISM OF THE CENTRAL RETINAL ARTERY. C. Z. KOTILIANSKAYA, Arch. oftal. **7**: 195 (July) 1930.

Two patients with embolism of the central artery of the retina were treated with injections of atropine sulphate in a dilution of 1: 1,000. The injections were introduced through the lower lid of the affected eye into the retrobulbar space. In one case, after four injections the vision improved from the perception of movements of the hands to 20/30. The optic disk remained pale two months after treatment. In the second case, the vision was normal after three injections. The fundus was normal two months after the injections had been made.

The author believes that, owing to the dilatation of the vessels caused by the injections of atropine, the embolus is driven into a smaller branch.

O. SITCHEVSKA

MULTIPLE ABSCESSES IN BOTH OPTIC NERVES CAUSED BY STREPTOCOCCIC SEPSIS. W. KYRIELEIS, Klin. Monatsbl. f. Augenh. **85**: 194 (Aug.) 1930.

A girl, aged 20, developed sepsis after infecting a finger.. Hemolytic streptococci were found in the blood, and small petecchial hemorrhages were noticed in the mucous lining of the cheeks, the soft palate and also in the skin. Congestion of the disks, enlarged and tortous retinal veins and a large preretinal hemorrhage were observed shortly prior to her death.

Histologic examination showed numerous small abscesses in the intra-orbital portions of both disks and larger abscesses on both sides of the lamina cribrosa; the infiltration spread along the septums of the nerves in some instances. The internal limitans membrane of the vitreous was lifted off by an exudation. Hemorrhages in the retina, hyperplasia and edema of the choroid and infiltration of the ciliary body

were noticed. This condition of metastatic ophthalmia was accompanied by a picture of the fundus resembling septic retinitis.

In the author's opinion, had the patient lived longer, bilateral panophthalmitis would have finally developed. The ocular symptoms, he believes, were produced by particles originating from the necrotic inflammation of the valves of the heart.

K. L. STOLL.

Uvea

A CASE OF UVEO-PAROTID FEVER. H. KAITZ, Brit. J. Ophth. **15**: 36 (Jan.) 1931.

Uveoparotid fever is a rare clinical condition, characterized by parotitis, uveitis, a mild fever, enlargement of the salivary glands and lymphatic nodes, and occasionally palsies of the cerebrospinal nerve. Whether or not the tubercle bacillus is the agent is in question. In one case, postmortem examination revealed evidence of miliary tuberculosis.

The author's case was that of a woman, aged 24. After a period of losing weight, both parotid glands became enlarged, accompanied by a temperature of 101 F. Under roentgen treatment, the parotid swelling diminished appreciably. Bilateral active iridocyclitis with precipitates on Descemet's membrane and a hazy vitreous with suggestion of papilledema developed. There was complete absence of positive tuberculous infection. The history of a discharging left cervical gland (which had been lanced) might suggest a tuberculous infection.

There was no record of a palsy of the facial nerve, the presence of which is regarded as typical by Heerfordt. There was a good general improvement and gradual subsidence of fever.

W. ZENTMAYER.

THE RÔLE OF TRAUMATISM IN CERTAIN FORMS OF IRITIS. FAGE, Arch. d'opht. **47**: 538 (Aug.) 1930.

In this paper the author calls attention to the generally accepted belief that traumatism is able to provoke the onset of interstitial keratitis, syphilitic skin eruptions and tuberculous arthritis. He expresses the opinion that there is no reason why other structures of the eye should not also be subject to a similar influence of trauma. He reports three cases of iritis, one syphilitic and two tuberculous, the onset of which followed traumatism. He points out the necessity of being as sure as possible of the honesty of the patient. The reality of the injury, its date, its nature and location and the integrity of the eye before the accident must be as firmly established as possible.

S. B. MARLOW.

Vision

WHAT INDICATIONS MUST BE MET BY THE SCALE OF VISUAL ACUITY? H. COPPEZ, Arch. d'opht. **47**: 428 (July) 1930.

Because so many documented reports on the subject of the standardization of visual acuity were received at the Thirteenth International Congress of Ophthalmology that public discussion was impossible, the question was left open until the next congress, all ophthalmologists being

invited to collaborate in order that some definite conclusions be reached. This situation stimulated the author to present his views in this article. He restricts himself to the clinical side of the question. One point that seems to be universally agreed on is that the graduation must be based on the decimal system. He presents a complete decimal scale of fourteen graduations which corresponds closely to a scale of fourteen terms in geometric progression from 1.0 to 0.10. He admits that this scale is not perfect but that it fits in well with clinical observation. The fourteen terms suggested are necessary for the observation of ocular disease and anomalies of refraction. They are not all necessary for the determination of the depreciation of working ability. For the examination of public employees, they correspond sufficiently to the standard types to be admissible.

S. B. MARLOW.

Visual Tracts and Fields

BINASAL HEMIANOPIA. C. DEJEAN, Arch. d'opht. **47:** 219 (April) 1930.

The author points out that previous communications have only the field changes as a common symptom. He classifies these reports into two groups: (1) those with ophthalmoscopic changes, (2) those without. The one point in common in the first group is that the field change appears in the course of the development of an optic atrophy. Infection takes priority as its cause. The lesion is probably situated in front of the chiasm. The cases that fall into the second group are much more uncommon than those in the first. Atheromatous degeneration of the circle of Willis, aneurysm of the internal carotid, pituitary tumor and cysts of the pituitary have been incriminated in these cases.

The author reports a personal observation which he thinks is to be explained by the contraction of granulation tissue produced by a meningitis at the base. He discusses the possibility of a periostitis which involves the clinoid processes as a factor. Whether it is a meningitic exudate or periostitis, he suggests that it is their interclinoid situation which by traction best explains the symmetrical compression of the chiasm and the appearance of the binasal hemianopia.

S. B. MARLOW.

Sympathetic Ophthalmia

THE FREQUENCY OF SYMPATHETIC OPHTHALMIA. G. DVORAK THEOBALD, Am. J. Ophth. **13:** 597 (July) 1930.

Records of the Illinois Eye and Ear Infirmary covering a period of twenty years were reviewed, during which time 206,592 patients came for treatment. Of these, 7,444 had cataracts extracted, 1,465 had perforating injuries, and 2,922 had operations for other intra-ocular inflammations. There were 22 enucleations after cataract extractions, and 29 following operations for relief of tension. Thirty-one cases of sympathetic ophthalmia were noted, in 23 of which enucleation was done; operation was refused in 8. The diagnosis was confirmed histologically in 11 of these cases, 8 of which were perforating injuries, 2 following cataract extraction, and 1 following iridectomy for glaucoma.

Enucleation for sympathetic irritation was done in 48 cases. A number of tables and photomicrographs are shown, and the histologic changes in several cases are described. The following summary is given:

1. These statistics show the greatest frequency of sympathetic irritation occurring in the first decade. There are four patients below the age of 10 years, and only one case for each of the following decades.

2. The statistics show that sympathetic ophthalmia is actually much less frequent than the enucleations which are done for sympathetic ophthalmia or for fear of sympathetic ophthalmia. However, the enucleations are justified, for with the present clinical knowledge one has no certain means by which to decide, at an early stage, whether one is dealing with sympathetic ophthalmia or with a less harmful infiltrating inflammation.

3. Diagnosis can be made only histologically. This may present some difficulty, as case 2594 shows. For this purpose each eye must be sectioned serially, and at least every tenth section carefully examined.

W. S. REESE.

NOTES ON SYMPATHETIC OPHTHALMIA. RESEARCHES ON ITS PATHOGENESIS AND OBSERVATIONS ON TWO CURED PERSONAL CASES. E. PUSCARIU, Arch. d'opht. **47**: 142 (March) 1930.

The author calls attention to the necessity of a careful study of the patient before the diagnosis of sympathetic ophthalmia can be properly made. The clinical picture of this disease is described, and attention is called to the rarity of its appearance during the World War and following operations for cataract and glaucoma. A review of the literature as to its pathogenesis leads the author to the opinion that future study should be bacteriologic. In the author's opinion, the weight of the evidence available is on the side of infection. Before presenting two detailed case reports, treatment is fully discussed. In conclusion, the opinion is expressed that methenamine, neoarsphenamine and mercuric cyanide will cure the mild cases. In the more severe, more energetic treatment must be used from the beginning. The observation of two cases with good results suggests a less pessimistic prognosis than is usual.

S. B. MARLOW.

Therapeutics

TREATMENT OF OCULAR DISEASES WITH MERCUROCHROME. E. R. CHAMBERS, Brit. M. J. **2**: 992 (Dec. 13) 1930.

This is an enthusiastic report of the use of mercurochrome-220 soluble in certain ocular diseases, in which it is regarded as a useful antiseptic without causing irritation. The disadvantage of its red staining can be remedied if the skin of the lids is immediately wiped off with moist cotton. The author advised the use of mercurochrome in the form of drops of 1 per cent solution, or an ointment of the same strength, or as a paint of 1 or 2 per cent strength. In conjunctivitis, the author finds the best method of treatment is to paint both lids immediately with a 1 or 2 per cent solution, depending on the severity of the attack. The solution is applied with cotton wrapped around the

tip of a fine probe. This painting is also of use in chronic cases in which there is a good deal of thickening of the conjunctiva. Mercurochrome seems superior to silver nitrate in that it is less irritating, and there is no danger of staining the conjunctiva. The painting is done twice a week, rather than giving a prescription of drops for the patient to use himself.

A 1 per cent solution of mercurochrome has been used in the maternity department of the Bristol Royal Infirmary, instead of the usual silver nitrate, in the eyes of new-born babies. However, if parents are known to have been infected with gonorrhea, silver nitrate is still used. In this condition, it can also be used in the initial stages, even where there is intense chemosis and swelling.

The author does not seem to be quite so favorably impressed with its action in corneal infections. Blepharitis, on the other hand, is definitely benefited by painting the lids with a 2 per cent solution. In two cases a curious idiosyncrasy seemed to be present, but this is apparently rare.

In ophthalmic surgery, as a preliminary to ocular operations, the author recommends painting of the skin of the lids and face of the patient, using a 1 per cent solution of mercurochrome, and before operations drops of 1 per cent solution to be instilled several times on the preceding day and before the operation.

A. KNAPP.

TREATMENT OF EYE CONDITIONS IN INDIA. E. R. SHETTI, Brit. M. J. 2: 1097 (Dec. 27) 1930.

The writer reports some of the methods of treatment carried out at the Henderson Eye Hospital, which is situated in Bijapur, Bombay Presidency. These are always interesting as they show what type of cases are common in that part of the world and what form of treatment, as the result of a large experience, they have found the best.

Keratomalacia is very common and is due to deficiency in the essential food elements. The first evidences show themselves in night blindness and dryness of the cornea and conjunctiva. The haze of the cornea increases and forms ulcers, with sloughing, perforation and panophthalmitis. The prognosis for cases seen in the early stage is excellent. A dose of santonin is first given, and the local treatment of the eyes consists in the instillation of pure cod liver oil and ethylmorphine hydrochloride and the application of ointment of yellow mercuric oxide, a pad and a bandage. The general condition must be treated. Injections of from 1 to 3 cc. of milk have been found of advantage in small children. Cod liver oil is rubbed into the skin, and the patient is given albumin water, thin milk and lime water.

In trachoma, a 10 per cent solution of copper sulphate is applied daily to the everted lids. The treatment for granulations consists of expression with the roller forceps and brushing with the solution of copper sulphate in glycerine. The eyes are treated daily with mercuric chloride, mild silver protein and ointment of yellow mercuric oxide. After the acute stages, from 0.5 to 1 cc. of a 1 per cent solution of copper sulphate with procaine hydrochloride is injected underneath the conjunctiva just behind the tarsus, once a week for three or four times.

In glaucoma, physostigmine (eserine) and drops of epinephrine are first used, and then iridectomy is done in acute cases and trephining in

chronic cases. For very high tension, an intravenous injection of 1.5 per cent solution of sodium chloride is given up to half a pint at a time. This reduces the tension and enables the trephining to be done safely.

Trephining with iridectomy is advised for staphyloma of the cornea when the cornea is not much thinned. This is also recommended for adherent opacity of the cornea, where the anterior chamber is very shallow, and is in close contact with the back of the cornea.

Recent staphylomas are often dealt with successfully by the use of physostigmine, ethylmorphine hydrochloride, epinephrine and pressure bandage. When the staphylomas are reduced in size, iridectomy or trephining with iridectomy can be done.

Cataracts are extracted by the intracapsular and extracapsular methods. During the past year there has not been a single case of prolapse of the iris, sepsis or large escape of vitreous. The eyes are irrigated with 1 to 6,000 solution of mercuric chloride before operation; the external canthus is generally split.

Corneal ulcers are treated with atropine and bandage, silvering of the lids being done for some days, when the ulcers are due to conjunctivitis. Septic and hypopyon ulcers are cauterized with camphor and carbolic acid, equal parts, and paracentesis of the anterior chamber is repeated as required. A few injections of iodine given intravenously hasten the cure.

In optic neuritis, retinitis pigmentosa and optic atrophy, besides treating the fundamental cause, which the author finds to be syphilis, septic tonsils and pyorrhea, an intravenous injection of iodine is given once every three or four days, until about six injections of ½ grain of potassium iodide and ½ grain of iodine in 10 cc. distilled water have been given. Mercurial ointment is rubbed into the temples daily, and deep injections of from 0.5 to 1 cc. mercuric oxycyanide 1:2,000 with procaine hydrochloride are given every week. Many cases have shown marked improvement with this treatment, and it is particularly striking to observe the improvement in vision which results after one or two intravenous injections of iodine. When there are no prominent veins, the following solution is given intramuscularly: sodium iodide, 250 grains (17.25 Gm.); iodine, 200 grains (14 Gm.); carbolic acid, 3 drachms (11.65 Gm.); distilled water, 4,000 cc. Of this, 10 cc. is injected into the gluteal muscles every week.

A. KNAPP.

A CONTRIBUTION TO PHOTOTHERAPY. C. GIUSEPPE, Ann. di ottal. e clin. ocul. **58**: 362 (April) 1930.

The author used the Birch-Hirschfeld arc-lamp with uviol filter, in cases of keratitis, the dosage being for from five to ten minutes every day or every two days in most cases, while in some severe cases the same dosage was given twice a day and rose bengal was instilled as a sensitizer before the treatment. Treatment was given in thirty-four cases. Of these, the seven catarrhal ulcers responded well, healing after a few applications. In five cases of phlyctenular keratoconjunctivitis, prompt healing occurred also, with practically normal vision. One herpetic ulcer healed after two treatments, and a later recurrence healed after three more treatments. Several cases which had resisted previous treatment healed rapidly on phototherapy. Of these one was a secondary infection

after a burn from lime, one an obstinate infiltrate of an old leukoma and one an ulcer with plastic iritis. Two early serpent ulcers healed promptly. Of ten other serpent ulcers of more severe type, all but three healed with useful vision and without perforation, while in the other three adherent leukomas resulted. The author concludes that phototherapy is of definite value in such cases.

S. R. GIFFORD.

LIVER THERAPY IN THE OCULAR LESIONS OF TRUE AND PSEUDO-PERNICIOUS ANEMIA. M. DEL DUCA, Ann. di ottal. e clin. ocul. **58:** 427 (May-June) 1930.

The author observed six cases of true pernicious anemia and two cases of anemia secondary to malaria and syphilis; large doses of partially cooked liver were given in all the cases. The condition was advanced in each instance with the typical picture in the fundus of retinal hemorrhages, turgescence of the veins and pallor of the disks. In all cases the hemorrhage cleared up rapidly as the general condition improved, a marked change being observed usually in two weeks. In four cases all the hemorrhages had absorbed during that time, leaving no visible traces. The pallor of the disks and retinal edema also improved rapidly, usually being practically normal after a month. In a few cases relative scotomas were left corresponding to the site of larger hemorrhages. No fresh hemorrhages were observed during treatment. In the two cases of secondary anemia, the effect of treatment on the general condition and picture in the fundus seemed as good as in the primary cases, but quinine and specific treatment were also employed.

S. R. GIFFORD.

ULTRAVIOLET THERAPY IN HERPETIC KERATITIS. M. DEL DUCA, Saggi di oftal. **5:** 616, 1930.

The author reviews the usual methods of treatment for this condition, which may be very resistant to all such methods and result in a marked loss of vision. Roentgen therapy was tried in six cases without results definite enough to recommend the method. With ultraviolet therapy, however, the Birch-Hirschfeld lamp with a uviol filter being used, excellent results were obtained. Rose bengal was used before treatment as a "sensitizer." In mild cases a treatment of from two to twelve minutes was employed every second day; in severe cases, five minutes twice a day. Of thirteen cases in which the patients were submitted to this treatment, healing was obtained in all. The tendency to healing was usually marked after two or three treatments, although from eight to ten were given in most cases. No recurrences have been seen among these cases.

S. R. GIFFORD.

Society Transactions

EDITED BY DR. GEORGE S. DERBY

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OPHTHALMOLOGY

Nov. 20, 1930

MAXWELL LANGDON, M.D., *Chairman*

AN EMERGENCY KIT FOR OPHTHALMIC EXAMINATIONS AND TREATMENTS. DR. E. A. SHUMWAY.

An emergency kit for ophthalmic examinations and treatments away from the office or hospital was presented. A physician's stock bag had been fitted with a rack holding six small bottles for ophthalmic solutions, with additional provisions for holding a cotton container, solutions of boric acid, etc., as well as with dressings and instruments. The outfit had proved entirely practical.

TRACHOMA IN WRESTLERS. DR. WILLIAM ZENTMAYER.

A recent case of trachomatous infection in the right eye of a wrestler was reported. The patient had been an athletic coach and had only recently taken up professional wrestling; he was aware of the prevalence of trachoma among wrestlers and was not surprised when this diagnosis was made of his trouble.

The presenter called attention to the contribution made eight years ago by the late Dr. Patton, who, with the late Dr. Gifford, saw eight cases of trachoma in wrestlers. It was Dr. Patton's belief that trachoma was transmitted during the course of wrestling matches; the contestants perspired freely, and when the referee is not looking too closely, often massage an opponent's eyes, as Dr. Patton suggested, to produce unconsciously the oculocardiac reflex.

The report of this case was deemed timely so as to call the attention of ophthalmologists again to this mode of transmission of trachoma that they may bring it to the notice of the health authorities of their respective communities in an endeavor to eliminate this source of infection.

DISCUSSION

DR. B. H. MANN: During the early part of last summer I observed two cases of trachoma in wrestlers who had been wrestling on various occasions. The first patient stated that his eyes had never been inflamed until after he was examined for a bout in one of the Southern states. He was the last to be examined among four or five wrestlers, and the examiner did not remove his gloves between examinations. The patient noticed this and when he later consulted me in Philadelphia told me about it. The other wrestlers no doubt had some acute inflammatory condition, whether trachoma or not the patient did not know, but two or three days later an acute conjunctivitis developed in the patient. The case did not turn out to be trachoma, but was an unusually acute conjunctivitis.

The second case was of much longer duration. The wrestler had been active in his profession for a number of years although he had had trachoma for several years. The conjunctiva, in his case, did not show follicles at the time that I examined him. On everting the lids, the conjunctiva of the upper and particularly of the lower lids rolled out in thick red folds.

This patient said that trachoma is prevalent among wrestlers, and mentioned the names of some who have the disease who are active in their profession, although every wrestler is examined before a bout. Of course, some of the cases are not trachoma, but in wrestling when the head is banged against the floor, and the dust arising enters the eyes, it causes chronic conjunctivitis, which is a part of trachoma. However, many wrestlers, of which the second patient is an example, do have trachoma, and many are being treated for it constantly wherever they go.

DR. M. E. SMUKLER: Two years ago, I saw a case of trachoma in one eye of a wrestler who at that time was champion wrestler of the world. The case was reported to the bureau of health, and the wrestler left Philadelphia for about six months. During his absence his lid was rolled and treated, and he was discharged by his oculist as cured.

The department of health then raised the question of whether or not he should be allowed to continue his profession in Philadelphia. Examination by the bureau of health revealed that there was no active inflammation in the diseased eye and no discharge from it, so it was not deemed necessary to bar him from continuing his profession.

DR. MAXWELL HERMAN: Dr. Zentmayer is to be commended for bringing to our attention a subject which seemed to exist as common knowledge among professional wrestlers and their training establishments and which they have designated as "wrestlers' sore eyes."

During the past two years I have had as patients professional wrestlers of whom two undoubtedly had trachoma. One presented a similar case to that of Dr. Zentmayer's patient. He was a man of some education who in his college days had been an athlete of intercollegiate standing and who had entered professional wrestling as a means of livelihood. He stated that he became infected with trachoma in the training establishments and that he recognized the needlessness of such infection. He said that the culprits in this matter have been foreigners who have brought in the infection, but who were champions in their profession and whose power and popularity were such that the "little fellows" could offer no protest There was little doubt in my mind that some of this so-called "wrestlers' conjunctivitis" is true trachoma. Dr. Zentmayer's paper and the publicity of this question among ophthalmologists may produce a great deal of good and bring justice to the professional wrestler.

HOW SHOULD THE OPHTHALMOLOGIST WRITE HIS PRESCRIPTIONS FOR GLASSES? DR. ALFRED COWAN.

A paper in which the ophthalmologist was urged to incorporate in his prescription the style and shape, as well as the effective power, of the lenses he prescribes, was read. The paper will be published in full in a later issue of the ARCHIVES.

DISCUSSION

DR. SIDNEY L. OLSHO: In convex spherical meniscus lenses up to +8, the —6 inside curve is constant, and they are supplied thus without any trouble by all optical shops. Convex plane cylinder toric lenses also have a constant —6 inside curve. But when a convex toric spherocylinder is to be ground, the front surface remains +6, combined with the cylinder, and the spherical effect is obtained by diminishing the degree of the inside surface instead of increasing the convexity of the front surface.

The objections to this method have been stated. Why is it persisted in when it is common knowledge that a constant —6 inside curve for powers up to +8 would provide a lens of more efficiency and wider angle?

The answer is that it is easier. When toric spherocylinder lenses superseded the flat forms, they came almost universally, for commercial reasons, to be ground with a constant +6 front surface base curve. Throughout the country the optical shops now have this set-up; they have the tools, they have the lens blanks and they have the habit. To change the inside base curve of all convex spherocylinder toric lenses up to +8 to a constant —6, as suggested by the presenter, is not a simple matter; it means revolutionary changes, the purchase of hundreds of new blanks and tools, and an unanimous discarding of the somewhat faulty but rapid method in vogue.

Instead of taking a single step forward, the national manufacturers have gone many steps farther by making point focal lenses universally available at only a slight advance over the present prices of ordinary toric lenses. This has been brought about by standardization and production on a huge scale. True it is, that some of the claims made for these lenses have been exaggerated, but it cannot be denied that they have great advantages, particularly those of higher foci. They afford a wider angle of efficiency than lenses less well balanced, and furthermore, the polish of these lenses is much finer.

The advance in the designing and marketing of lenses would be delayed for many years were the commercial incentive to the manufacturers not present. The low price of the toric lenses now in use is dependent on the mass production of lens blanks and molds by national manufacturers. In the field of bifocal lenses we are using proprietary types without giving the matter a thought. The several concerns marketing point focal lenses employed distinguished scientists to work out the best possible curve combinations. In general, the teachings of Tscherning were followed, but the results are not ideal. There are commercial and technical limitations.

Let me turn back for a few moments to the discussion of toric lenses. Some of the larger optical shops have the tools not only to grind a +6 base front curve but also +3 and +9 base curves. This increases the range in which these opticians can operate in an attempt to equalize the inside curves of an unequal pair of lenses. It also affords at times a means of approaching the most efficient relation between the inside and outside curves. Too, as has been pointed out by the speaker, more efficient combinations may often be secured by transposition. He said that he wished to point out that specifications for surfacing lenses often

involve special and costly grinding. A real point focal lens would in many instances be less costly and perhaps better.

In the several series of point focal lenses the surfacing problems have been worked out more or less in advance. This helps those not familiar with the juggling of base curves and transpositions. The point focal lens may not be ideal, but the error will be fractional. I doubt whether a specially surfaced, ordinary toric lens would be more perfect. If a lens requiring unusual surfacing must be replaced in any but the shop in which it was first purchased, the chance of a change in the identical surfacing is very high. A standardized lens is more apt to be replaced without error.

MODIFIED LAGRANGE OPERATION. DR. J. MILTON GRISCOM.

The details of a modified Lagrange operation were presented.

DISCUSSION

DR. B. F. BAER: I performed this identical operation first in December, 1929. Owing to the extreme shallowness of the anterior chamber encountered in many glaucomatous patients, the Lagrange procedure required modification because of the inability to use the keratome safely. In eyes with extremely shallow chambers, an incision was made with a Graefe knife, and the sclera slightly beveled just before the completion of the section.

During the past eleven months, either the one or the other of these methods has been used in operations on about twenty-eight or thirty eyes, with a subsequent rise in tension in two eyes, which has been easily controlled by the resumed use of miotics. In none of the cases has quiet iritis been observed, nor was there further degradation in the central vision or the peripheral fields. The operation has been extremely satisfactory and far less dangerous than Lagrange's operation. In no case has prolapse of the vitreous or ciliary body been encountered.

DR. G. E. DE SCHWEINITZ: I wish to express my satisfaction that Dr. Griscom has introduced to the Section his method of performing sclero-iridectomy for the relief of glaucoma, for it is an operation that is of definite value.

Seventeen years ago, shortly after David Priestley Smith published his technic, to which Dr. Baer has referred, I adopted a much less complicated procedure, one which was, in fact, precisely similar to that which Dr. Griscom has just described, and in all instances (always cases of chronic glaucoma) the results were eminently satisfactory, although the operations have been few in number.

About a year ago I suggested to my associate, Dr. Baer, a return to this method of operating, and the results, as the Section has heard, were entirely satisfactory. In no case was there failure to secure an adequate fistulous area, although in two cases there was a return of increased tension, which was quickly controlled by miotics; quiet iritis did not develop in any of the eyes on which operation was performed, and in none of them was there a dangerous lowering of the intra-ocular tension.

It is interesting that two surgeons operating in the same hospital have been unconscious of the fact that we were utilizing an exactly similar technic.

Naturally, considerable additional experience with this modified Lagrange procedure will be necessary before its permanent value can be established.

DR. C. E. G. SHANNON: The modified Lagrange operation as suggested by Dr. Griscom appeals strongly to me by reason of its simplicity. In completing the section, the classic Lagrange operation always presents the danger of cutting into the ciliary body. This modified procedure, however, obviates this danger to a great extent. Some operators make the scleral section with the keratome before dissecting the conjunctival flap. To my mind, this accentuates the risk of introducing the knife beneath the iris, an accident that recently befell a skilful operator, much to his chagrin.

I shall be interested in trying out the operation at the earliest opportunity.

DR. GEORGE H. CROSS: I have never tried the modification of the Lagrange operation as suggested by Dr. Griscom, as the results in the last fifteen cases in which the classic Lagrange technic was used were satisfactory. The Ridley cataract knife was used in all of these, the sharp point permitting one to enter a very narrow anterior chamber and thus make the scleral section.

THE BACTERIOLOGIC AND IMMUNOLOGIC ASPECTS OF IRITIS, WITH SPECIAL REFERENCE TO ITS RELATIONSHIP TO BACTERIAL ALLERGY. DR. JOHN A. KOLMER, by invitation.

Attention was drawn by the presenter to the lack of acceptable data bearing on the etiology of chronic recurrent iritis associated with focal infection, and a plea was made for more systematized bacteriologic investigations in this disease.

Iritis of exogenous origin, as well as tuberculous and syphilitic iritis, may be regarded as well established from the etiologic standpoint, but the iritis of focal infection still requires a great deal of investigation to ascertain the exact mechanism of infection.

The opinion was expressed that in the majority of instances chronic recurrent iritis was probably a streptococcus infection, with some cases due to the gonococcus, staphylococcus, pneumococcus and other organisms.

The occurrence of streptococcus iritis secondary to primary streptococcus infection in the tonsils, apexes of the teeth, etc., does not necessarily involve acquired selective affinity of the organisms for the iritis, although the experimental production of iritis among rabbits by intravenous injections of broth cultures of streptococci from such primary foci strongly suggests this possibility.

It is probable that toxins elaborated in primary foci may be responsible for iritis rather than the bacteria themselves. An experimental method for studying this phase of the problem was outlined.

Attention was drawn to the points of resemblance between iritis and acute and chronic arthritis of streptococcus origin, with the possibility of iritis being due to acquired allergic sensitization of the iritis to streptococcus toxins.

It was suggested that autogenous vaccine therapy be employed as a routine measure in the treatment for chronic recurrent iritis when

streptococci, staphylococci or pneumococci are recovered in cultures of probable primary foci, as the removal or drainage of primary foci alone may not result in recovery.

In view of the possibility and probability of iritis being due in whole or in part to toxins, it was suggested that vaccines contain the soluble or exogenous toxins in addition to organisms killed by heat or chemicals.

DISCUSSION

DR. EDWARD A. SHUMWAY: As a point of practical value in the treatment for iritis due to focal infections in various parts of the body and especially those in the prostate, I should like to say that while injections of gonococcal vaccine were most valuable in cases in which the gonococcus was present in the secretion after massage of the prostate, many cases were found in which there were no gonococci and only a mixed type of ordinary pus organisms. According to urologic specialists, such cases are common, and treatment with an autogenous vaccine is indicated in them.

The administration either of the gonococcal vaccine or of a vaccine prepared from the pus organisms present should be followed up by the injection of one of the milk preparations, which will give a good nonspecific protein reaction. Such a case has been under my care recently, and this method has been followed with marked success, the acquiring of perfect vision.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

WILLIAM F. C. STEINBUGLER, M.D., *Secretary*

Dec. 15, 1930

ERNEST F. KRUG, M.D., *Chairman*

RECURRENT EPIDERMOID CARCINOMA. DR. A. H. COCHRAN, JR. (by invitation) and DR. G. ALLEN ROBINSON.

This article will be published in full in a later issue of the ARCHIVES.

DISCUSSION

DR. BEN WITT KEY: This is an extremely interesting case, and one which must be rare. It seems to argue in favor of the infectious theory of malignancy. I am particularly interested because Dr. Cochran quoted from my report of a case of epibulbar basal cell carcinoma, in which the pathway of penetration of the globe was traced along the ciliary vessels, into the subchoroidal space, forward into the layers of the corneal substance, without penetration of the uvea. The growth destroyed the inner commissure, forming a pansy-like lesion by destruction of the adjacent skin of the lids and nose in a peculiarly symmetrical manner. This was accounted for by the action of the lids against the growth, and by the act of convergence of the globe. This case therefore argued in favor of the theory of mechanical activation. Dr. Cochran's case presents a number of interesting phases of this subject, and especially

certain possibilities in the future observation and treatment of it. A later report should prove of value.

A Case of Keratoconus with Müller's Contact Lenses (Lantern Slides). Dr. Olga Sitchevska (by invitation).

Examination of the eyes revealed a typical bilateral keratoconus. Vision of the right eye was 10/200; that of the left eye, 6/200. High spherocylinders improved the vision but slightly. The Abderhalden dialysis test done in Halle, Germany, showed a hypofunction of both the thyroid and the thymus glands. The coagulation time of the blood was diminished.

The patient was taken to Professor Clausen's clinic at Halle. There, of approximately 100 Müller's contact glasses, the patient chose three pair which he could wear comfortably. He also tried the Zeiss glasses, but could not wear them. The vision of the right eye with the Müller glass was 20/20; that of the left eye, 20/30, without any correction. He had worn them for one year and three months, from eight to ten hours daily. Occasionally the eyes became irritated. For that reason he wore one glass at a time, allowing the almost constant use of one eye. No diplopia was observed.

According to many authors (Clausen, Ziegrist and Jaensh), the Müller glasses are worn with greater comfort than the Zeiss glasses. The explanation for this is most likely in the shape; the Müller glass has a broad scleral part forming a base for the corneal segment and has its support at the lower fornix. The narrow edge of the Zeiss glass that fits the sclera snugly may produce too much pressure. Besides, the Müller glass allows free passage of the lacrimal fluid into the space between the glass and the cornea. When mercurochrome-220 soluble is instilled into the patient's eye with the glass on, it fills the space and disappears within a few minutes. On the other hand, the Zeiss contact glasses have a great advantage over the Müller glasses because they can be ground to a perfect spherical surface. The Müller contact glasses, being blown, cannot be made optically correct. A large number of glasses must be tried on until the patient obtains the proper one, which is often an arduous task for both the patient and the physician.

At present, the contact glasses are the best means of improving the vision of patients with keratoconus. The glasses have not only an optical, but a therapeutic value (Clausen). Serving as a bandage, they prevent the cornea from further ectasia and thus check the progress of the disease. Operative procedures should be undertaken only as a last resort.

DISCUSSION

Dr. Laurance D. Redway showed color photographs of the conus with and without the contact glass. He also showed two plates of a cerulean cataract.

Dr. James Watson White: An artist with keratoconus was able to get vision of 20/20 in one eye with a blown contact glass, which he obtained in New York. He is able to wear it comfortably for six hours.

Dr. Olga Sitchevska: There is a firm in New York City that makes blown glasses similar to the Müller glasses, but this patient could

not wear them. The representative of the firm said that Müller Brothers of Wiesbaden, Germany, uses a certain crystal for the contact glasses which no one else can obtain.

PUNCTURE OF THE ANTERIOR CHAMBER IN GLAUCOMA. DR. PETER C. KRONFELD, UNIVERSITY OF CHICAGO (by invitation).

This article will be published in full in a later issue of the ARCHIVES.

DISCUSSION

DR. H. H. TYSON: The results of Dr. Kronfeld's investigations are interesting. They seem to confirm the late Dr. Herman Knapp's observations on the aqueous in eyes with a tendency to glaucoma. On performing discission for secondary cataracts in these cases, he found that in eyes in which much aqueous was lost, there was a tendency to a rise in tension on account of the increase in the protein content of the reformed aqueous. I should like to know whether a chemical analysis of the aqueous has been made in Dr. Kronfeld's cases, and, if so, whether he has found an increase in the protein content, as this would partly account for a diminished filtration and a more rapid rise in the tension, as his results show.

DR. BEN WITT KEY: I should like to ask if I understood Dr. Kronfeld correctly, that he classifies glaucoma into "retention" glaucoma and secondary glaucoma.

DR. MARTIN COHEN: I wish to thank Dr. Kronfeld for his presentation. He has studied only twenty-five cases of glaucoma, and undoubtedly will continue the work as that number is too small on which to base a definite opinion with respect to this subject.

I should like to ask whether the permeability of the walls of the ciliary capillaries is responsible for the rapid hypotonic state of the eyeball. Is it possible that a fistulous tract might be responsible for the diminished tension? A fluorescein test, regardless of diffusion, might be of value.

DR. MARK J. SCHOENBERG: I was interested in Dr. Kronfeld's paper for a number of reasons. First comes the practical question as to whether he has ever seen an acute attack of glaucoma after one of these punctures. The procedure, that of measuring the tension a number of times after a puncture of the anterior chamber, sounds quite dangerous. We know that once in a while an attack of acute glaucoma occurs in a patient after the simple procedure of tonometry. I do not say that the procedure is dangerous, but it looks as if it might be.

I should also like to hear more about the exact technic of puncturing the anterior chamber. We know that the cornea is a rather resistant tissue. It is hard to get through the sclera, and it is even harder to puncture the cornea. To my mind, the most important part of this work, as Dr. Kronfeld said, is not so much the diagnosis as the number of doors it opens theoretically, which will help us to understand a little more about the nature of glaucoma. His interpretation of the response of the normal and the glaucomatous eye to puncture of the anterior chamber is interesting. It seems that the manner of this response depends on a reflex vascular reaction. The fact that the ocular tension varies in both eyes when one of them is punctured seems to speak in

favor of the theory of a vascular reflex. The various "Belastungs" tests in glaucoma, such as keeping the patient in a dark room for half an hour or more, placing the patient in a reclining position with the head below the level of the chest, the administration of strong coffee and tea or the pressure on the jugular veins by the aid of a "Vasco" or of my own apparatus, seem to bring out the latent predisposition to an increase of intra-ocular tension via the vasomotor reflex. Dr. Kronfeld's procedure could be ranged among the "Belastungs" tests and may give valuable information regarding the problem of ocular hypertension.

DR. LAURANCE D. REDWAY: I have been able to take the intra-ocular tension with the Schiötz tonometer of four men directly after electrocution; it was zero. The pressure in the left ventricle was 10 mm. of mercury.

DR. PETER C. KRONFELD: In order to answer Dr. Tyson's question, I presented no case in which I did the puncture twice within one hour, but I have done this a number of times.

During the chemical examination of the second aqueous, which I did in a number of cases and reported, I invariably found an increased amount of protein. It was a misleading statement that Hagen set forth in 1920, when he said that the second aqueous did not contain more protein than the first. If you examine the patient on whom you did the puncture with the slit-lamp, you will see something like this: The anterior half of the anterior chamber seems to be clear. In the posterior half, coming out between the pupillary margin and the lens, you will see a ring-shaped cloud apparently limited in its anterior part by a layer of coagulated fibrin and enclosing a layer of aqueous with a high amount of protein. There can be no question that the second aqueous in the human eye contains more protein than the first. In the glaucomatous eye, the second aqueous reaches the upper limit of 0.3 per cent of protein.

As to Dr. Key's question, it is true that my first differentiation was between eyes (group 1) showing glaucoma due to retention and eyes (group 2) in which the glaucoma was not caused by retention alone. In the first group, there are some cases of primary glaucoma, certain types of secondary glaucoma and possibly the secondary glaucoma that occurs in cases of thrombosis of the central vein. In group 2, the disturbance in inflow, in my opinion, seems to be the leading factor, and in this group I should like to include most, but not all, of the primary glaucomas. In the same group I found a certain number of secondary glaucomas, especially of the type in which the glaucoma comes on with the first attack of cyclitis. So you see, this differentiation does not coincide with the differentiation between primary and secondary glaucoma. In group 2, I have made a few subdivisions, which I have not worked out very well as yet, and I would not like to say much about them.

I agree with Dr. Cohen's suggestion of continuing these experiments on a large scale, and we are doing that at the University of Chicago; so far, we have studied 27 primary and 35 secondary glaucomas, and our total figure on punctures is around 150 to date.

The last statement also answers Dr. Schoenberg's question as to the danger involved in puncturing the anterior chamber. When I did the first puncture, I was afraid something might happen, but I have never seen any complication.

In regard to the question of fistulization: we have used fluorescein and have studied the eyes under the slit-lamp. When taking tensions during the stage of hypotony, we usually put the tonometer on the cornea twice and we have not observed any difference between the two readings. I believe that we have fairly well ruled out the possibility of fistulization.

In order to reply to Dr. Schoenberg's questions, which have thrown some new light on the whole problem, I would like to say that I have never seen an acute attack of glaucoma following puncture. Dr. Fuchs asked me the same question when I addressed the Ophthalmological Society in Vienna. The tension goes up after the puncture, but some force from the inside seems to control the whole process in that the tension always goes down by itself. The reactive hypertony is invariably followed by a reactive hypotony, so you need not be afraid of the high tension.

The main point that I wanted to bring out is that the punctures of the anterior chamber have taught me many things about glaucoma. It is the same thing that Dr. Schoenberg pointed out, and I am grateful to him.

In reply to Dr. Redway's statement, I am not familiar enough with all the changes that take place immediately after electrocution. It probably is a complex matter. In my statements concerning the normal eye after death, I referred to the tension of the normal eyes of patients taken within four hours after death; we have always found the tension between 10 and 15. What happens at the moment of electrocution, I do not know. It is interesting to me that the tension goes to zero right away, probably indicating complete paralysis of the capillaries.

I wish to thank you for your kindness and patience in listening to my possibly incomplete and rather theoretical interpretation, but the underlying observations are facts about the glaucomatous eye, and glaucomatous eyes are certainly common enough in our practice so that it would be worth while to know a little more about them.

THE PRESENCE OF VITAMIN A IN THE RETINAL TISSUE. DR. ARTHUR M. YUDKIN.

An examination of the hog, both by the methods of the color reaction of Rosenheim and by the feeding of experimental animals depleted of vitamin A, has shown the presence of this food factor. The content of vitamin A is not inconsiderable, for only 20 mg. of the dried retinal tissue daily is necessary for growing animals on an otherwise adequate diet. By similar experiments it was demonstrated that the retinal tissue is decidedly richer in vitamin A than ordinary butterfat and is therefore as potent as good cod liver oil. Chemical analysis of the retina reveals 20 per cent of ether-extractable substance and the residue, 18 per cent of alcohol-extractable material. The former gives the positive vitamin A reaction, whereas the latter does not. It is also apparent from this work that the outer layers of the retina must contain the greatest amount of this food factor. If the body is depleted of vitamin A, the retina must also lose a good portion of this substance. In consequence of this disturbance, it might be expected that the structure of the retina will be undermined and pathologic sequelae arise.

DISCUSSION

DR. PETER C. KRONFELD: I was greatly impressed and surprised by the fact that Dr. Yudkin found vitamin A in large quantities in the retina. It is the next thing to assume that the amount of vitamin which is present locally probably plays an important rôle in all of the visual phenomena. Up to this time I always believed that the amount of vitamin that was circulating in the lymph fluid and the blood stream was the essential factor, and now Dr. Yudkin has taught us that it is present in the retina, which suggests the possibility that this vitamin plays an important rôle, in these particular tissues, in the biochemistry of the visual processes.

DR. MARK J. SCHOENBERG: Although I have to confess my ignorance of advanced chemical problems, I still must express my doubt as to the wording of the title of the paper: "Vitamin A in the Retinal Tissue."

I should like to ask Dr. Yudkin whether he is convinced that the substance found in the retina is really vitamin A. I am not entirely convinced that the evidence is so absolute as to assume the presence of vitamin A in the retina, even if this substance gives the same Rosenheim reaction, and even if it improves the general condition when fed to animals deprived of vitamin A. Perhaps vitamin A-like substance in the retina is a more correct designation.

DR. MARTIN COHEN: I studied lipoids in the blood in twelve cases of retinitis pigmentosa and found no increase in these cases.

In regard to the retina containing vitamin A, I should like to ask whether Dr. Yudkin has isolated the factor which is vitamin A. Might there not be some other important factors in the retina, such as the inorganic salts of sodium and potassium, which play an important rôle in the nutritional element of the retina? Has the normal chemistry of the retina and the choroid been studied so that one can differentiate chemically between the choroid and the retina of rats? Such work has been done on man, but I do not know whether there is any difference in the rat.

DR. OLGA SITCHEVSKA: There is a fasting period in Russia of seven weeks' duration, before Easter. The people are not allowed to eat meat or any kind of fat. Every year at that period the peasants go to the eye clinic complaining of night blindness. Clinically, there are no symptoms of retinitis pigmentosa. The hemeralopia disappears shortly after the patients resume a normal diet and drink cod liver oil.

DR. ARTHUR M. YUDKIN: The two most important methods were utilized to determine the presence of vitamin A in the material used. The basal diet contains the vitamins (except fat-soluble A). We know that the animals do well on such a basal diet until their body is depleted of vitamin A, and then if the missing food factor is not added to the diet ocular disturbance develops in the experimental animal and it finally succumbs. Autopsy reveals the invasion of infection in the tissue.

As yet no one has isolated vitamin A in a pure state, even though many investigators have reported its presence in many tissues and plants. The color reactions devised by Rosenheim and Drummond to detect the presence of vitamins are significant, but are not specific. Therefore, when the color reaction and the biologic feeding tests reveal the presence

of the respective positive reactions, we must take it for granted that vitamin A is present.

In a recent publication on carotin, Moore called attention to the possible substitution of this pigment substance for vitamin A in feeding experiments. Carotin does not give a positive vitamin A color reaction or a spectroscopic band.

Very little experimental work of this type has been done on the retina. We do not know what effects organic and inorganic salts may have on the retinal tissue. The basal diet contains the Osborne and Mendel salt mixture, which has been used at the Department of Physiological Chemistry and the Connecticut Agricultural Station in feeding tests on more than 18,000 albino rats. The combination of salts was found to be adequate enough to aid the growth of the animals.

True enough, the exact chemical nature of the vitamins is still unknown, but with the utilization of the three methods that I have mentioned, biologic feeding experiments, the color tests of Drummond and Rosenheim and spectroscopic examination, it ought to be possible to distinguish one factor from another. The factors are probably contaminated, but the contamination is not the same in all tissues, so that positive observations can be interpreted only as significant of the presence of the food factor in question.

THE BLUE ARCS OF THE RETINA AND A PROBABLY ALLIED BLUE AFTER-IMAGE. DR. BENJAMIN FRIEDMAN (by invitation).

This article will be published in full in a later issue of the ARCHIVES.

EMBOLISM OF THE CENTRAL RETINAL ARTERY. DR. THOMAS H. CURTIN.

S. S., a white man, presented himself on Dec. 13, 1930, with the history of a sudden and complete loss of the sight of the left eye three weeks previously. After three hours the sight returned, and, on consulting his physician, he was advised to refrain from work for a week, which he did. Seventeen days after his first experience, he again lost the sight of the left eye, with the exception of a small area in the center. Physical examination revealed myocarditis with enlargement. On ophthalmoscopic examination, the left pupil was found to react consensually, but not directly. The optic nerve head was pale, except toward the temporal side. The arteries were narrowed or entirely absent. There was retinal edema except in a small area extending from the disk outward to the macula, which area was supplied by a cilioretinal artery. This patch appeared normal and corresponded to the part of the visual field that remained intact. No cherry-red spot was visible.

THROMBOSIS OF THE BRANCH OF THE CENTRAL RETINAL VEIN. DR. THOMAS H. CURTIN.

DISCUSSION

DR. MARTIN COHEN and DR. E. F. KRUG discussed this paper.

INFANTILE GLAUCOMA WITH HYPOTONY AND COMPLICATED CATARACTS. DR. MARTIN COHEN.

B. K., a girl, aged 10, had had the usual diseases of childhood. The parental history was irrelevant. Physical examination, including the congenital anomalies (with the exception of the one presented) and the Wassermann test, gave negative results.

The mother had noticed a prominence of both eyes since infancy, although the child had had fairly good vision until two years before examination, when a disturbance in vision and the appearance of a whitish color of the pupillary area were noted.

The patient was first examined at the clinic on Dec. 1, 1930, but failed to return for further examination. There was no vision at that time. Horizontal nystagmus was present in both eyes. The iris markings were indistinct; no iridokinesia was present. The lenses were cataractous and had a yellowish appearance. The intra-ocular tension, taken digitally, was markedly reduced in both eyes. The cornea appeared enlarged, globular and slightly cloudy; the aqueous was slightly cloudy.

A diagnosis of bilateral infantile glaucoma in the stage of degeneration was made.

ROYAL SOCIETY OF MEDICINE, LONDON (ENGLAND), SECTION OF OPHTHALMOLOGY

MR. H. DICKINSON, *Reporter*

Jan. 9, 1931

MR. ELMORE BREWERTON, *President*

MARGINAL DEGENERATION OF THE CORNEA. MR. DOGGART.

(Mr. Doggart showed a patient, aged 21, who had complained of failure of vision in the left eye for a year, and during that time he had had several attacks of mild conjunctivitis. There was a marginal opacity of the left cornea, extending from 8 to 2 o'clock, and it was vascularized by vessels running inward and radially. These vessels were limited by a sinuous white line. The condition was in the early stage, and probably at a later stage ectasia would develop. Vision in the left eye was 6/9, with minus the sphere plus 2 cylinder at an axis of 30 degrees.)

DISCUSSION

SIR RICHARD CRUISE: This does not seem to me to be a degenerative condition, but a sluggish form of subepithelial infiltration from an infective source. The lids are quite smooth.

CONJUNCTIVITIS. MR. GAYER MORGAN.

(Mr. Gayer Morgan presented a case of conjunctivitis, which was regarded as Parinaud's type, and was found to be tuberculous, owing to a positive reaction following the injection of some granulations into a guinea-pig. There were well marked cock's comb granulations in the lower fornix, and enlargement of follicles in the upper fornix over the

tarsal plate. There was also a large gland under the angle of the jaw, and a palpable preauricular gland. Commencing last March, the eye had been exposed to a carbon arc lamp, at first one minute twice a week, the time being gradually increased to two and a half minutes twice a week. Improvement had been continuous, and at the time of presentation the gland which had been large and soft was small and hard, and the tubercle had disappeared.)

DISCUSSION

MR. WOLFF: In Parinaud's conjunctivitis there is a tendency for the conjunctival condition to clear up and for the glandular condition to remain, either for a long time or permanently.

MR. GIMBLETT: In a similar case of mine there was a great excess of lymphocytes. The gland in front of the ear broke down and discharged, afterward healing, and the conjunctival condition subsided. That was three months ago.

MR. J. H. FISHER: It would be interesting to know whether the form of tubercle bacillus responsible in these cases is the bovine or the human type. In ordinary glandular tuberculosis in children it is the bovine form, the infection taking place through the nasopharyngeal mucous membrane.

MR. P. G. DOYNE: In three cases of this kind that I exhibited at the Section, there was a history of the conjunctiva having been scratched with the finger-nail.

COLOR BLINDNESS. MR. F. E. PRESTON.

(Mr. F. E. Preston presented a patient dangerously color blind according to the Edridge Green test, but he was able to pass the test on railway signals, even in the recent fog and at a fair distance. According to the presenter, there seemed to be need for a means of distinguishing dangerous from nondangerous color blind people, since that the chief requirement is to be able to tell red from green.)

DISCUSSION

MR. ELMORE BREWERTON: The use of more than two lights in road signalling is against a relaxation of the tests.

MR. LESLIE PATON: I have just finished a model for the purpose of teaching students, which I call a diplopia demonstrator. By it students can easily be shown the different forms of diplopia from paresis of different muscles.

EXTRACTION OF CATARACT WITH CONJUNCTIVAL BRIDGE. MR. NORMAN FLEMING.

(Mr. Norman Fleming read a paper and gave a cinematograph demonstration on his modification of the operation for extraction of cataract with conjunctival bridge. He said that he was bringing forward this communication because the results had given him so much satisfaction, and the film brought out clearly details which could not be so well described in words.

Mr. Fleming first made a preliminary irrigation, cleaning out both fornices with swabs mounted on Indian sticks in a stream of saline. One advantage of the method is that it obviates touching the palpebral

conjunctiva with the fingers when everting the upper lid. Next, he opened the capsule of the lens by means of a slightly curved vertical incision made with a Ziegler knife, which need not be followed by any loss of aqueous. For the Graefe section, he entered at the same point, and when cutting upward included a broad band coming out above and just beneath this membrane and dividing it upward by two parallel cuts 6 mm. in length. Then the knife was withdrawn from under the bridge. For the removal of the lens, an iris repositor which had its end bent to an angle of 90 degrees was introduced under the bridge, and the lens was pressed slightly downward by a stroking movement on the sclerotic. While it was held in this position, a curet was applied to the cornea in order to make the lens present in the usual way. The iris repositor was then discarded, and a needle pushed into the lowest available part of the periphery of the lens, and with this the lens was rotated out of the eye without exerting further pressure. Any remaining lens matter is, if the operator wishes, washed out, and the operation completed. He used the Madras bandage.

Mr. Fleming thought it would be agreed that, provided it was successful, cataract extraction without iridectomy gave the best result, and, so far, he had found that bridge extraction, because it fixed the lips of the wound and there is rapid healing, offered a safeguard against prolapse, which justifies the omission of an iridectomy. The latter could, however, be done if desired, and it would be facilitated by fashioning the bridge somewhat to one side, as recommended by Mr. Leslie Paton.

Speaking of the results following this procedure, Mr. Fleming said that if all went well 6/6 vision could be expected, as the bridge held the cut surfaces in good apposition, the wound healed quickly, and there was but little reaction or astigmatism. In his last eighteen cases in which this procedure was used there was one failure, and that patient was an aged and decrepit woman in whom panophthalmia developed within two days of the operation, and though the culture was sterile, it probably was an endogenous infection.)

DISCUSSION

Mr. Elmore Brewerton: Most ophthalmic surgeons do the bridge operation in septic cases which do not seem to respond to any method of treatment.

Mr. B. Cridland: I have been operating with this method for eight years. When I began to use it, I took fifty consecutive cases, and in nearly all of them I did a simple extraction. Some of them were difficult to do, as more manipulation was required to get the lens out than if one does not use a bridge. In one of the cases I had to cut the bridge in order to get the lens out; but, on the whole, the results were eminently satisfactory. I had to deal with many men who were "squeezers," and the method was very valuable because if one released the lid and the patient "squeezed" it did not matter. At a discussion at the Oxford Ophthalmological Congress, the late Sir Anderson Critchett said he would be eclectic in deciding whether he would use a bridge or do an iridectomy, and I have since adopted the same principle; I try to use the bridge operation, but have not always done so. This method reduces the stay of patients in the hospital; the average time in the hospital of my fifty cases was only twelve days. I covered only the eye

which has been operated on, and the patients were happier if allowed up on the second or the third day. The performance of an iridectomy depended on the incision; one cannot always make an incision which comes out exactly at the limbus; part of the incision may be in the cornea, and it is in those cases that prolapse is likely.

MR. F. A. WILLIAMSON-NOBLE: I have been using an oblique bridge, cutting upward and outward all the time. Prolapse occurred in one or two cases, and I passed an iris repositor under the bridge and freed the conjunctiva.

MR. M. S. MAYOU: Some years ago I took cultures from various parts of the conjunctival sac. The upper fornix was nearly always sterile, but the lower fornix nearly always contained organisms, and the caruncle invariably had organisms. I never turned up the lid to wash out the conjunctival sac, as it disturbed the patient before the operation, and I do not think it is necessary. The main attention should be given to the lower conjunctival sac.

MR. NUTT: Mr. Pooley of Sheffield always does a bridge operation, but the bridge is not quite complete. That renders the delivery of the lens and the subsequent iridectomy much easier. It is a mere button-hole iridectomy, but is sufficient to prevent the tendency to prolapse.

MR. AFFLECK GREEVES: The most important point about the conjunctival flap is to get a good fringe of conjunctiva all the way round, bridge or no bridge.

MR. F. JULER: The films are the best of the kind I have ever seen.

MR. LINDSAY REA: A drop of atropine in the conjunctival sac before operation saves prolapse afterward. This is the routine method used at my hospital.

COLONEL KIRKPATRICK: Paresis of the orbicularis produced by an injection into a branch of the facial nerve is a help to a successful result.

MR. MALCOLM HEPBURN: I do not think that any kind of section will make any difference in prolapse of the iris, as the question of the latter depends on the condition of the iris.

MR. MAURICE WHITING: Mr. William Lang always paid particular attention to the reaction of the pupil before doing cataract extractions, and if the pupil was sluggish he did a complete iridectomy; otherwise, he carried out simple extraction. In this respect, the condition of the iris was most important.

SIR RICHARD CRUISE: The most important thing in the prevention of prolapse is to saturate the eye with atropine beforehand and contract the iris into a peripheral ring. In my private cases I have not had to do iridectomy for prolapse for fifteen years.

CATARACT FROM EXPOSURE TO X-RAYS. MR. R. FOSTER MOORE.

(Mr. R. Foster Moore read a paper concerning a man, aged 28, in whom cataract developed due to exposure of the eye to heavy doses of x-rays during treatment for sycosis of the face. The patient was seen by dermatologists because of severe sycosis of the scalp, face and neck, of three years' duration, during which time he had been to several

hospitals, the treatment having included x-rays, which the patient said made him worse. In this last treatment, owing to there being certain risks attending the roentgen treatment, a signed statement was obtained from the man expressing his willingness to have the treatment. The disease affected the eyelashes as well as other parts of the face. The treatment lasted from February to June, 1927, and the total amount was 12 Sabouraud doses. The sycosis was completely cured, and had not recurred, but telangiectases gradually appeared, and remained, apparently unchanged, until the present time. In November, 1929, the patient's sight began to fail, the visual acuity in March, 1929, being 6/12 in each eye; since Christmas, 1929, he had been unable to read a book. In June, 1930, when Mr. Moore saw him, the vision was only 6/60 in each eye, and there was a plaque-like opacity in the posterior cortex of each lens, and bordering this was a powdery opacity. The fundi were normal. Last May he needled the right cataract, and in October Mr. J. G. Milner needled the other. The process was uneventful, and after capsulotomy the acuity in the right eye was 6/6; absorption of the left was not yet complete, but was running a normal course. Most of the opacity was in the substance of the lens, adjacent to the posterior capsule.

Mr. Foster Moore referred to the first case of the kind, reported in 1909 by Mr. Leslie Paton, and others reported since. In all the recorded instances the dose of x-rays had been heavy, and efficient protection of the eyes had not been possible. He commented on the length of time which elapsed between the exposures and the condition of the lens, two and a half years in the present case. He thought that even when the eyelids needed treatment, a nicely adjusted shield would give the eye necessary protection.)

DISCUSSION

MR. ELMORE BREWERTON: Every effort should be made in such cases to protect the eye from the irradiation.

Book Reviews

ADMINISTRATION REPORT OF THE GOVERNMENT OPHTHALMIC HOSPITAL, MADRAS, FOR THE YEAR 1929. By LT. COL. R. E. WRIGHT. Price, 1 rupee, 8 annas. Pp. 43.

The daily attendance in 1929 was 290 for the outpatient and 225 for the inpatient department.

Operations for cataract were done with a bridge flap, and the results were satisfactory. The rate of occurrence of prolapse of the iris has been reduced to 1.07 per cent. The rate of occurrence of vitreous escape was 1.97 per cent. The Barraquer procedure was used in 119 cases. A large number of persistent, shallow chambers were observed (since the adoption of the bridge flap, 3 per cent, owing to adhesions of the capsular tags to the corneal endothelium. In many cases, as the chamber reformed, the adhesion broke away. In a few cases the use of the iris repositor during the second week after operation separated this adhesion. This is the only complication that seems to have increased in frequency since the introduction of the bridge flap. As was stated in an article on the O'Brien procedure in the ARCHIVES (**2**: 691 [Dec.] 1929), this method of akinesis has replaced the routine blocking of the seventh nerve, and has given satisfactory results. The visual results obtained in work on cataract are given, showing that simple extraction was done in 1,857 cases, with complete iridectomy in 400, peripheral iridectomy in 951 and marginal iridectomy in 7.

A biochemical examination of the blood of patients with glaucoma has been made without proving of practical value.

The epinephrine pack proved to be of definite value, and has found a definite place in the routine procedure. There was often an initial rise in tension, followed by a slow fall which reached its lowest point on the third day. This was generally maintained for not more than a week and then a rise set in. The frequent use of eserine before and after the pack tended to diminish the initial rise. Therefore, it was found more effective to combine physostigmine (eserine) drops with epinephrine. The epinephrine pack was found to be of advantage, especially before operation in bad cases. This procedure was described in the *British Medical Journal* for Sept. 7, 1929. An epinephrine substitute was found unsatisfactory. In the operative technic of trephining, bleeding points were readily controlled by a light touch with the electrocautery. In 114 cases, trephining was performed for primary glaucoma.

A number of interesting cases are described in detail: the occurrence of subhyaloid hemorrhage during vomiting; a report of three cases of amblyopia caused by tobacco, two of the three occurring in Europeans, while it is relatively uncommon in Indian patients; a report of changes in the fundus in eclampsia; a case of amblyopia caused by quinine; certain interesting familial diseases, and a rather complete report of superficial punctate keratitis, which appeared in the *British Journal of Ophthalmology*, June, 1930. Up to the end of 1929, 3,500 cases were observed. Finally, the importance of keratomalacia in India, of which there were 95 cases, was stressed, and compared to 59 cases of ophthalmia neonatorum.

The report of the pathological department follows with detailed descriptions of a number of tumors. Treatment with radium for conditions of the eyes is listed. Details illustrating these various features and a number of photographs complete this interesting report, which shows the enormous amount of work that is being admirably done for the Indians by Colonel Wright and his staff.

A. K.

COLLECTED REPRINTS FROM THE WILMER OPHTHALMOLOGICAL INSTITUTE OF THE JOHNS HOPKINS UNIVERSITY AND HOSPITAL. Volume 1, 1925-1929. Baltimore, 1930.

This volume contains the photographs of the rooms, the dedication and floor plans of the Wilmer Institute. Then follow the addresses given at the dedication, by Prof. E. Fuchs, Professor de Schweinitz and Sir John Parsons, and forty-five papers written by Professor Wilmer and other members of the staff, most of which have appeared in special and general journals, during the years 1925 to 1929. They furnish an imposing array of contributions in all fields of ophthalmology, and are indicative of the good work that is being done at the Wilmer Institute.

A. K.

Directory of Ophthalmologic Societies *

FOREIGN

British Medical Association, Section on Ophthalmology

President: Mr. E. E. Maddox, Glenartney, Poole Road, Bournemouth, England.
Place: Eastbourne. Time: July 22-24, 1931.

Oxford Ophthalmological Congress

Master: Dr. A. B. Cridland, Salisbury House, Chapel Ash, Wolverhampton, England.
Secretary: Dr. C. G. Russ-Wood, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford. Time: July 8-11, 1931.

Société Française d'Ophthalmologie

Secretary: Dr. René Onfray, 6 Avenue de La Motte Picquet, Paris 7è.
Place: Paris. Time: May 4-7, 1931.

NATIONAL

American Medical Association, Section on Ophthalmologgy

Chairman: Dr. George F. Suker, 25 E. Washington St., Chicago.
Secretary: Dr. William C. Finnoff, Imperial Bldg., Denver.
Place: Philadelphia. Time: June 8-12, 1931.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. F. Barnhill, Miami Beach, Fla.
President-Elect: Dr. S. Hanford McKee, 1528 Crescent St., Montreal.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: French Lick, Indiana. Time: Sept. 14-19, 1931.

American Ophthalmological Society

President: Dr. Arnold Knapp, 10 E. 54th St., New York.
Secretary: Dr. Emory Hill, Professional Bldg., Richmond, Va.
Place: Asheville, N. C. Time: June 1-3, 1931.

SECTIONAL

New England Ophthalmological Society

President: Dr. S. Judd Beach, 704 Congress St., Portland, Me.
Secretary-Treasurer: Dr. E. B. Dunphy, 520 Commonwealth Ave., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. Chester H. Bowers, 1136 W. 6th St., Los Angeles.
Secretary-Treasurer: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Albert E. Hillis, 1115 Pacific Ave., Seattle.
Secretary-Treasurer: Dr. Francis A. Brugman, 806 Cobb Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

Sioux Valley Eye and Ear Academy

President: Dr. Claude T. Uren, City National Bank Bldg., Omaha.
Secretary-Treasurer: Dr. Frederick H. Roost, 420 Trimble Bldg., Sioux City, Iowa.
Place: Fontanelle Hotel, Omaha. Time: November, 1931.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Fletcher D. Woodward, Box 162, University, Va.
Secretary: Dr. William D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Place: New Orleans. Time: November, 1931.

Southwestern Michigan Triological Society

President: Dr. Wilfrid Haughey, 65 W. Michigan Ave., Battle Creek.
Secretary: Dr. R. H. Fraser, Battle Creek Sanitarium, Battle Creek.
Time: Third Thursday of alternate months.

STATE

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Donald H. O'Rourke, 217 Imperial Bldg., Denver.
Place: First floor, Metropolitan Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

Connecticut State Medical Society, Section on Eye, Ear, Nose and Throat

President: Dr. Dorland Smith, 836 Myrtle Ave., Bridgeport.
Secretary-Treasurer: Dr. Walter L. Hogan, 750 Main St., Hartford.
Time: May, November.

Eye, Ear, Nose and Throat Club of Georgia

President: W. L. McDougall, 50 Whitehall St., S. W., Atlanta.
Secretary-Treasurer: Dr. William O. Martin, Jr., 412 Medical Arts Bldg., Atlanta.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. John W. Carmack, 23 E. Ohio St., Indianapolis.
Secretary: Dr. J. Kent Leasure, 23 E. Ohio St., Indianapolis.

Iowa Academy of Ophthalmology and Oto-Laryngology

President: Dr. Gordon F. Harkness, 215 Main St., Davenport.
Secretary-Treasurer: Dr. W. F. Boiler, 105 E. Iowa Ave., Iowa City.

Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Dr. John C. Brown, 350 St. Peter St., St. Paul.
Secretary-Treasurer: Dr. Hendrie W. Grant, Lowry Bldg., St. Paul.

Montana Academy of Oto-Ophthalmology

President: Dr. Lee W. Smith, 125 W. Granite St., Butte.
Secretary: Dr. J. G. Parsons, Lewistown.

North Dakota Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. B. Beeson, 232 W. De Mers Ave., Grand Forks.
Secretary-Treasurer: Dr. F. L. Wicks, Valley City.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. W. McCollom, 346½ Washington St., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

Rhode Island Ophthalmological and Otological Society

President: Dr. Raymond F. Hacking, 105 Waterman St., Providence.
Secretary: Dr. Herman A. Winkler, 224 Thayer St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

Utah Ophthalmological Society

President: Dr. Franklin H. Raley, 9 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. H. Leroy Smith, 1005 Medical Arts Bldg., Salt Lake City.

Virginia Society of Oto-Laryngology and Ophthalmology

President: Dr. Fletcher D. Woodward, Box 162, University.
Secretary-Treasurer: Dr. Henry Grant Preston, Harrisonburg.
Place: Richmond. Time: May 2, 1931.

West Virginia State Medical Association, Eye, Ear, Nose and Throat Section

President: Dr. S. S. Hall, Fairmont.
Secretary: Dr. G. A. Smith, Montgomery.
Place: Clarksburg. Time: May 19-21, 1931.

LOCAL

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

Chairman: Dr. J. Wallace Hurff, 86 Washington St., Newark.
Secretary: Dr. Earl LeRoy Wood, 31 Lincoln Park, Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

Academy of Medicine of Toronto, Section of Ophthalmology

Chairman: Dr. P. J. F. Houston, 34 Hurndale Ave., Toronto.
Secretary: Dr. Alexander E. MacDonald, 151 Bloor St., W. Toronto.
Time: First Monday of winter months.

Atlanta Academy of Ophthalmology and Oto-Laryngology

President: Dr. John R. Childs, 45 Edgewood Ave., Atlanta, Ga.
Secretary: Dr. William O. Martin, Jr., Medical Arts Bldg., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St., N. E. Time: 8 p. m., last Thursday of each month.

Baltimore Medical Society. Section on Ophthalmology

Chairman: Dr. Angus Lloyd MacLean, Johns Hopkins Hospital, Baltimore.
Secretary: Dr. Henry F. Graff, 513 N. Charles St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Brooklyn Ophthalmological Society

President: Dr. John N. Evans, 23 Schermerhorn St., Brooklyn.
Secretary: Dr. Michael J. Buonaguro, 589 Lorimer St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday of February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. A. F. Luhr, 40 W. North Ave., Buffalo.
Secretary-Treasurer: Dr. Thurber Le-Win, 112 Linwood Ave., Buffalo.

Chicago Ophthalmological Society

President: Dr. Harry S. Gradle, 58 E. Washington St., Chicago.
Secretary: Dr. Richard C. Gamble, 30 N. Michigan Ave., Chicago.
Place: Medical and Dental Arts Club. Time: Third Monday of each month from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. William V. Mullin, 9204 Euclid Ave., Cleveland.
Secretary: Dr. H. C. Rosenberger, 2064 E. 9th St., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. W. E. Burner, Guardian Bldg., Cleveland.
Secretary: Dr. M. P. Motto, Rose Bldg., Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. Maxwell Langdon, 1530 Locust St., Philadephia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. A. M. Hauer, 327 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. Albert D. Frost, 681 E. Broad St., Columbus, Ohio.
Time: First Monday of each month.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. B. Decherd, 1717 Pacific Ave., Dallas, Texas.
Executive Secretary: Dr. W. Mood Knowles, 1717 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. Parker Heath, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. G. G. Marshall, 122 West St. Rutland, Vt.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.
Time: Third Wednesday of October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. J. J. Richardson, 606 Penn St., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Needham, 1304 Medical Arts Bldg., Forth Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. Claude C. Cody, 1306 Walker Ave., Houston, Texas.
Secretary: Dr. J. M. Robison, Eye, Ear, Nose and Throat Hospital, Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

Indianapolis Ophthalmological and Oto-Laryngological Society

President: Dr. E. L. Lingeman, 241 N. Pennsylvania St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, Hume-Mansur Bldg., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

KANSAS CITY SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. A. E. Eubank, Argyle Bldg., Kansas City, Mo.
Secretary: Dr. O. S. Gilliland, Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

LONG BEACH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Dean E. Godwin, Security Bldg., Long Beach, Calif.
Secretary-Treasurer: Dr. Ferris Arnold, Security Bldg., Long Beach, Calif.
Place: Pacific Coast Club. Time: Last Wednesday of each month from September to June.

LOS ANGELES COUNTY MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Eugene R. Lewis, 727 W. 7th St., Los Angeles.
Secretary-Treasurer: Dr. J. Frank Friesen, 727 W. 7th St., Los Angeles.
Place: California Lutheran Hospital, Assembly Room. Time: 8 p. m., first Monday of each month from October to May, inclusive.

MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA, SECTION OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

Chairman: Dr. James A. Flynn, 1511 Rhode Island Ave., Washington.
Secretary: Dr. E. R. Gookin, Medical Science Bldg., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month.

MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

MILWAUKEE OTO-OPHTHALMIC SOCIETY

President: Dr. Herbert F. Wolters, 130 Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. O. P. Schoofs, 324 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

NASHVILLE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Hilliard Wood, 700 Church St., Nashville, Tenn.
Secretary-Treasurer: Dr. H. C. Smith, Medical Arts Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month.

NEW ORLEANS OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

President: Dr. W. R. Buffington, 211 Camp St., New Orleans.
Secretary-Treasurer: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Chairman: Dr. E. F. Krug, 12 W. 44th St., New York.
Secretary: Dr. William F. C. Steinbugler, 815 Park Ave., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

OMAHA AND COUNCIL BLUFFS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. George B. Potter, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. J. C. Davis, 425 Aquila Court, Omaha.
Place: Medical Tea Room. Time: 5:15 and 7:00 p. m., third Wednesday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Rochester Eye, Ear, Nose and Throat Society

Chairman: Dr. Clyde Heatly, 11 N. Goodman St., Rochester, N. Y.
Secretary-Treasurer: Dr. John F. Gipner, 53 S. Fitzhugh St., Rochester, N. Y.
Place: Rochester Medical Assn., 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

Pittsburgh Slit-Lamp Society

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

St. Louis Ophthalmic Society

President: Dr. Martin H. Post, 508 N. Grand Blvd., St. Louis.
Secretary: Dr. Carl T. Eber, 1006 Carleton Bldg., St. Louis.
Place: St. Louis or Washington University Cafeteria.
Time: 6:30 p. m., fourth Friday of each month from October to April, inclusive.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. T. J. Walthall, 728 Main Ave., San Antonio, Texas.
Secretary-Treasurer: Dr. E. D. Dumas, 425 Medical Arts Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. W. F. Swett, 693 Sutter St., San Francisco.
Secretary: Dr. Robert C. Martin, 384 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Third Tuesday of every month except May, June, July and December.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. Paul A. Remington, Old National Bank Bldg., Spokane, Wash.
Secretary: Dr. Louis A. Parsell, Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. Searle B. Marlow, State Tower Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. A. Harry Rubenstein, Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.